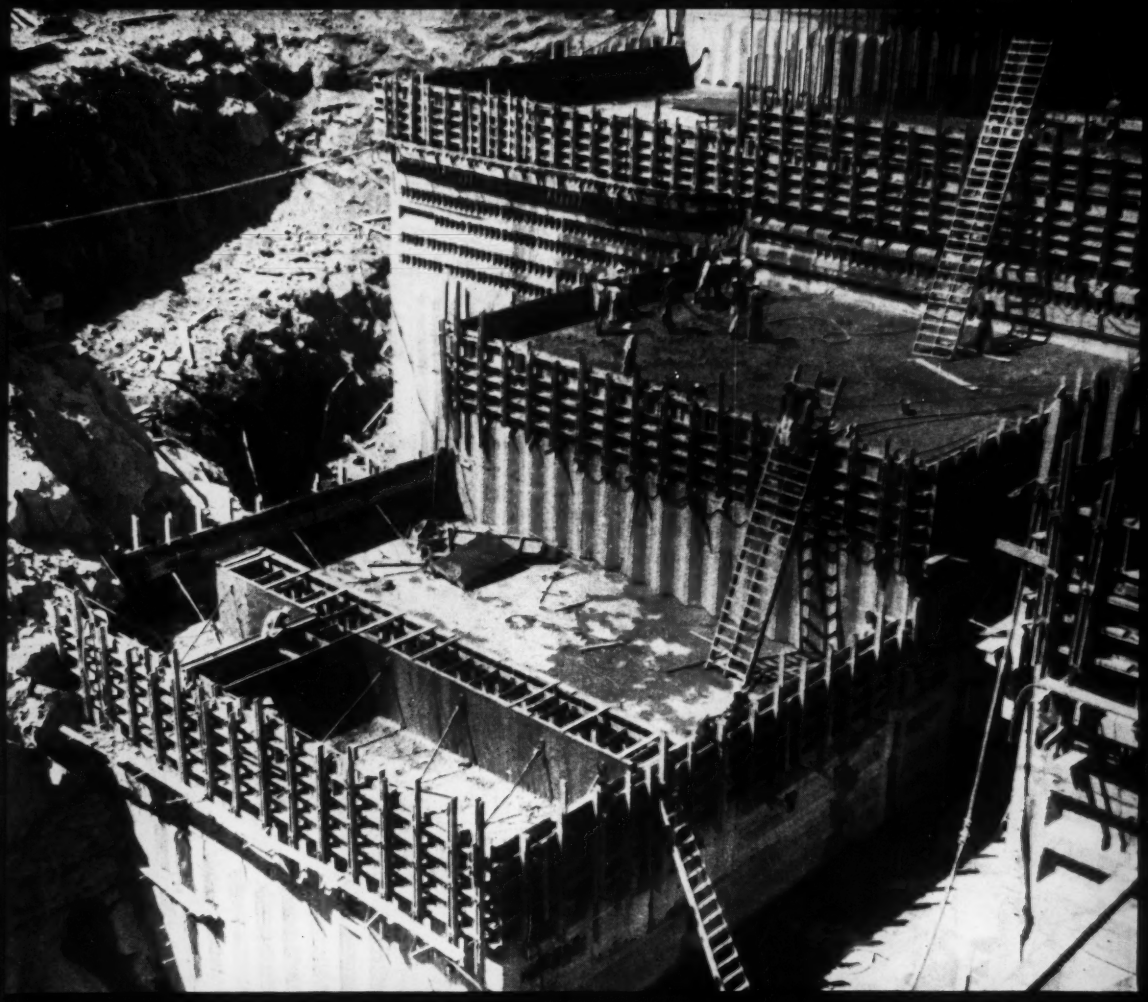
CIVIL ENGINEERING

JOURNAL OF ENGINEERED CONSTRUCTION



WESTERN METHODS IN INDIA – SEE ARTICLE ON BHAKRA DAM – SLOCUM AND PALTA

AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852

National prestressed pool package for 16′ x 32′ pool — $1300

Pre-Stressed, Pre-cast Concrete Units Solve Labor Costs

The NATIONAL POOL package includes all fittings special interlocking concrete units, vertical pre-stressing bars, marble-lite material for interior finish and complete filter system. Construction requires no special equipment and can be done with inexperienced local labor. Specially designed precast interlocking concrete wall sections fit into each other and solves cost problem. Pool walls are scientifically pre-stressed to prevent cracking. New method puts swimming pools within reach of all budgets.

PRICES START AT $1,300.00 for 16′ x 32′ PRIVATE POOL COMPLETE WITH FILTER SYSTEM, PUMP, MOTOR AND FITTINGS. PUBLIC POOL PACKAGE PRICE STARTS AT $3464.00 for 20 x 40 POOL. PUBLIC POOL PACKAGES ARE AVAILABLE FOR OLYMPIC SIZE POOLS.

Superior equipment—filter systems—underwater lights—ladders—vacuum cleaners—diving boards—heaters—paint for pool construction. Write for catalogue and price list.

Refer to the May issue of Coronet magazine on NATIONAL POOLS

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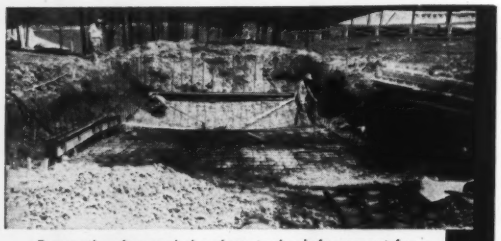
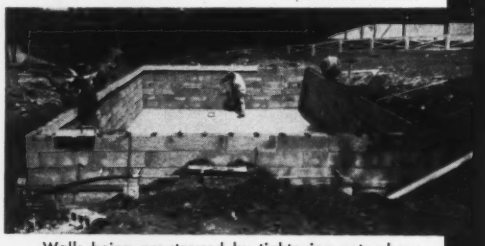


Excavation for pool showing steel reinforcement for floor and inside pool walls.

Vertical pre-stressing steel rods are ready for interlocking precast concrete units to be placed over them. No heavy construction equipment needed. All work can be done with inexperienced labor.



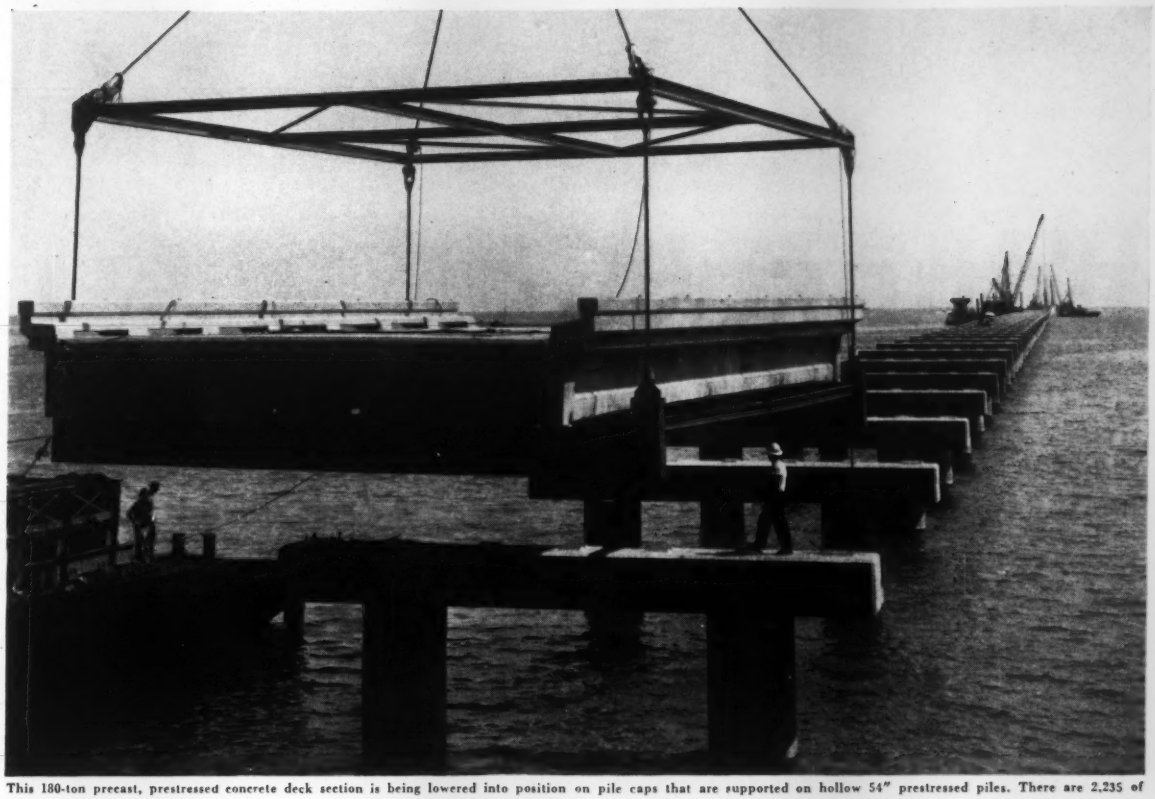
Walls being pre-stressed by tightening nuts above steel bearing plates, after concrete mixture has been poured inside pre-cast concrete sections. Prevents cracking. No forms needed.

The finished pool has been coated inside with snow white marble-lite. Tile border and coping around top.

NATIONAL

pool equipment co.

2516 Eighth Court, N. Birmingham, Alabama



This 180-ton precast, prestressed concrete deck section is being lowered into position on pile caps that are supported on hollow 54" prestressed piles. There are 2,235 of these deck spans on the 24 mile causeway across Lake Pontchartrain near New Orleans.

Why They Used Plastiment in the World's Longest Highway Bridge...

Efficient single unit beam-and-deck design and economical mass production are outstanding features of this 24 mile causeway across Lake Pontchartrain. Each day eight 56 foot deck-spans are cast in a single bed containing pretensioned wires.

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ECONOMY—An economical 6½ bag concrete mix, with varying proportions of Plastiment, results in uniform high structural quality well above specifications. Ease of placement and compaction, a characteristic of low slump Plastiment concrete, reduces placing costs.

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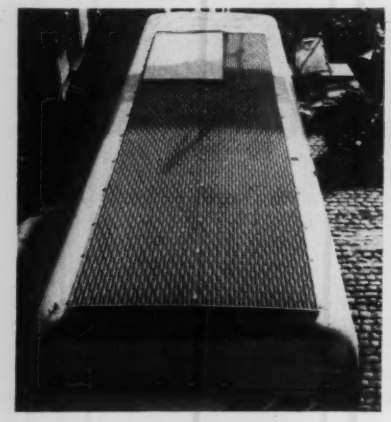
NEW USES OF GRATING . . . WHERE ONLY BORDEN QUALITY WOULD DO . . .

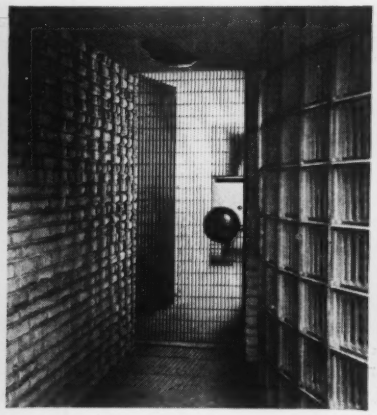
Here on this page are a few of the many new uses for grating being pioneered every day. Each is an exacting job where only standards of quality equal to BORDEN'S will do.

And remember . . . BORDEN manufactures every type grating in ferrous and non-ferrous metals.

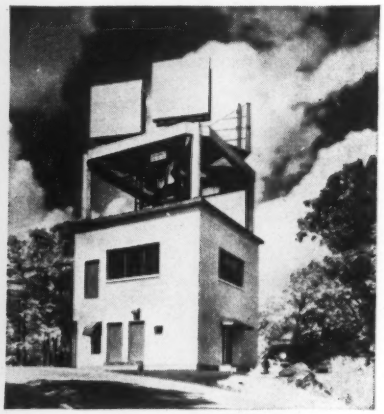
Light aluminum grating for SUN SHADES on buildings is in perfect harmony with modern design—allows 80% passage of light and air without the accompanying penetrating rays of the sun.



Wherever this Color Television truck goes, whatever the assignment of the reporters who must mount its roof, BORDEN riveted *serra-crimp* grating will mean surerfooting — even in ice or snow.



Only the finest precision manufacturing would satisfy the architect who designed this door. BORDEN is recognized as a leader in quality, custom-manufactured gratings.



Television relay stations and radar stations that gird our continent have adopted grating as standard outside platform material. It will not collect snow as most other platforms will.

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Member Audit Bureau of Circulations
43,800 copies of this issue printed

CIVIL ENGINEERING

AUGUST 1956
VOL. 26 • NO. 8

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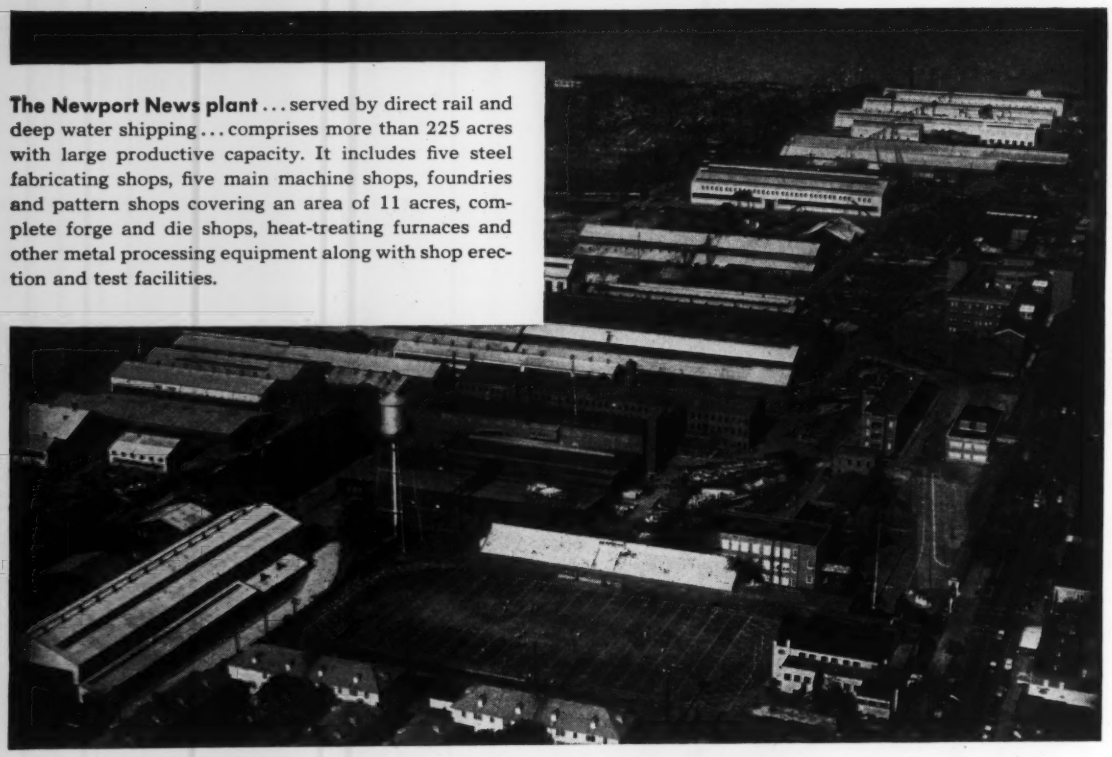

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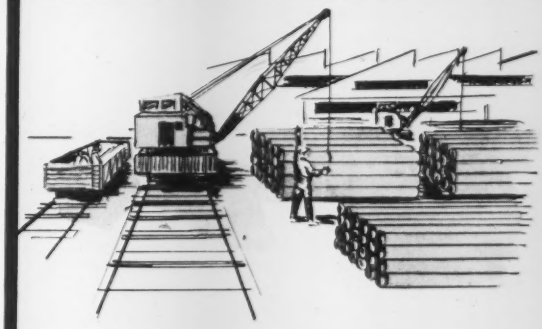

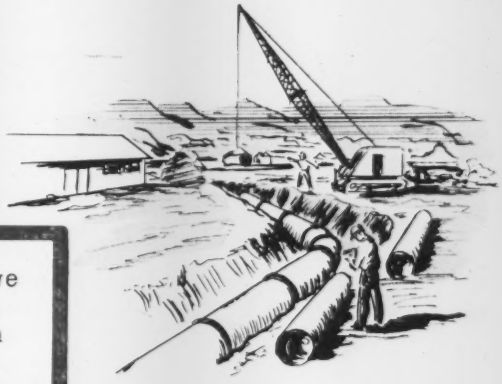

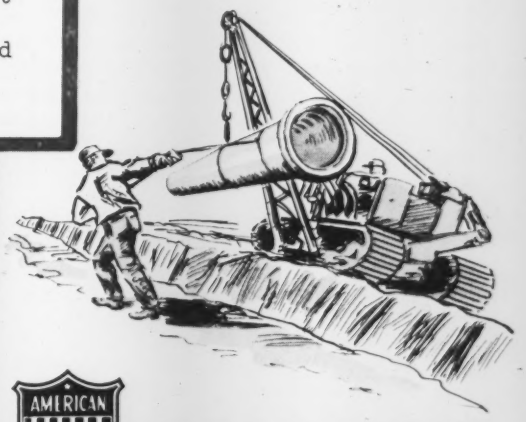

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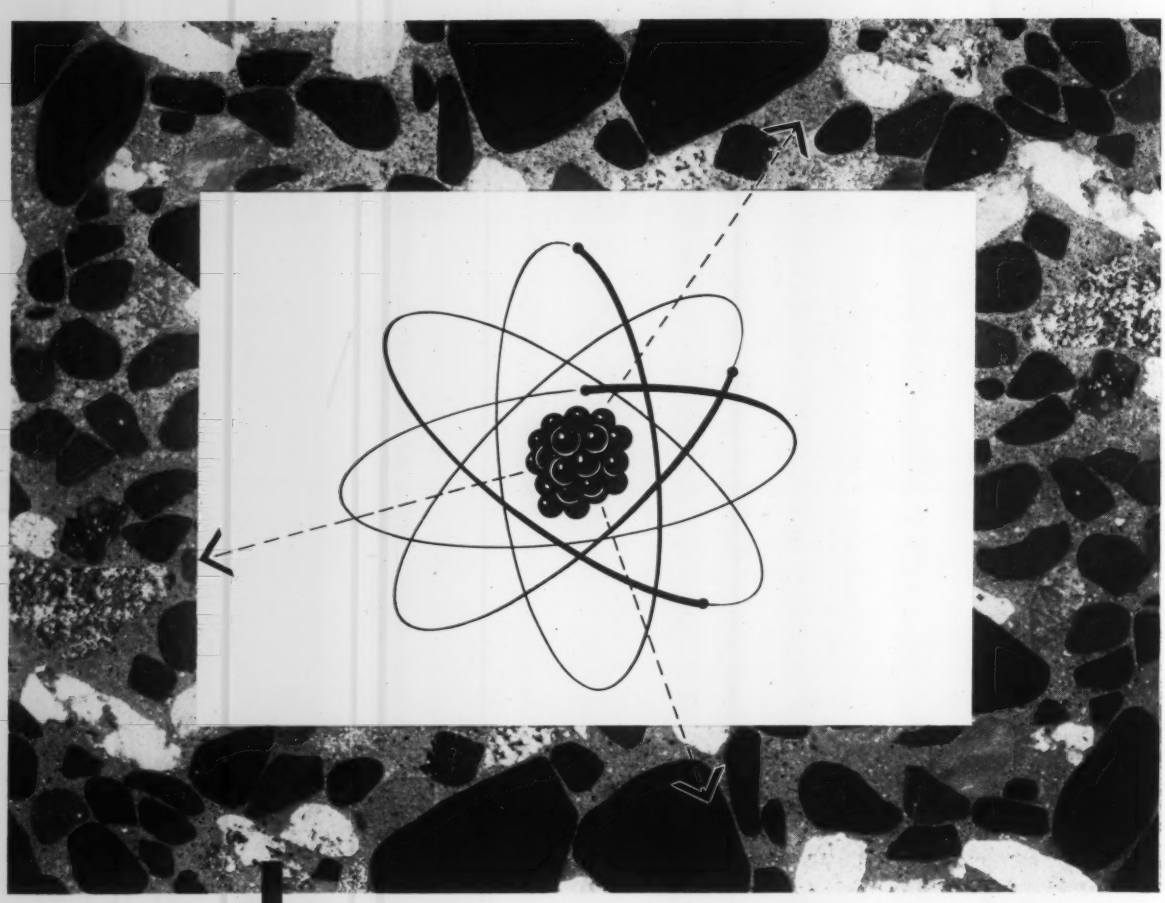

"heavy" concrete for reactor shields

High-density concrete, an efficient and practical radiation shielding material, is destined for wide use in nuclear reactors.

The high density results from the use of heavyweight aggregates and affords 1½ to 2 times more radiation protection than normal weight concrete of equal thickness. Its higher unit cost is offset by overall cost savings, which on one project amounted to $7,000,000!

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A new technical bulletin on "High-Density PREPAKT *Concrete" is now in preparation. We will be glad to send you a copy. Send a request on your letterhead, please.*

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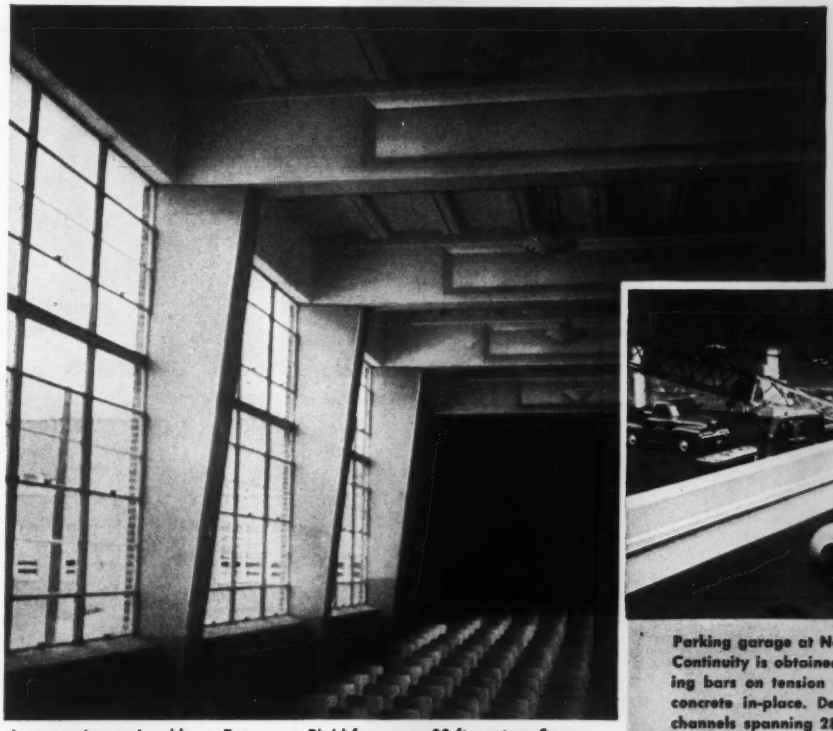
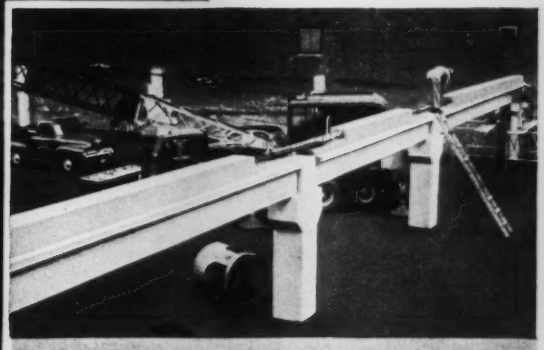
Use precast prestressed concrete!

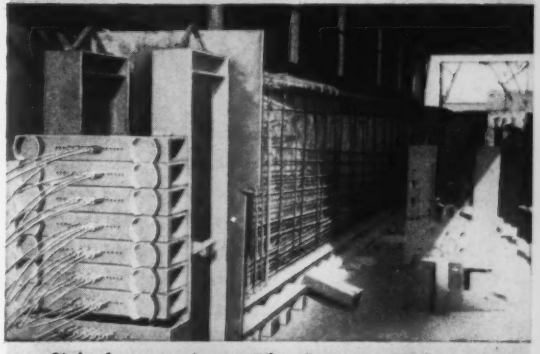


A gymnasium at Lynchburg, Tennessee. Rigid frames on 20-ft. centers. Span 62 feet. Prestressed girder of rigid frame is 3 feet deep . . . connected to precast reinforced columns and made continuous by welding reinforcing bars projecting from each member. Deck between frames is 6-in. deep prestressed concrete channels.

All structures illustrated were designed by Ross H. Bryan, Consulting Engineer . . . girders fabricated by T. L. Herbert & Sons . . . joists, slabs and channel decks fabricated by Nashville Breeko Block and Tile Company, all of Nashville, Tenn.



Parking garage at Nashville, Tenn. Girders span 38 feet. Continuity is obtained over columns by lapping reinforcing bars on tension side and pouring small amount of concrete in-place. Deck between girders is prestressed channels spanning 28 feet.



Girder for gymnasium at Milan, Tennessee. 100-ft. span girders 5½ feet deep spaced 20 feet on centers. 7-wire strands are deflected to approximate parabolic cable curve desirable on long spans. Strands are pre-tensioned, deflected, and then the concrete is poured. Deck is 8 inch x 12 inch prestressed block joists on 5-ft. centers and covered with precast lightweight slabs.

SINCE THE FIRST simple span bridge in the United States was completed in 1950, plant-fabricated prestressed concrete members have come a long way. As pictured here, all the advantages of continuous girders, rigid frames and long spans can now be combined with the economy and durability of precast pre-tensioned bonded prestressed concrete members.

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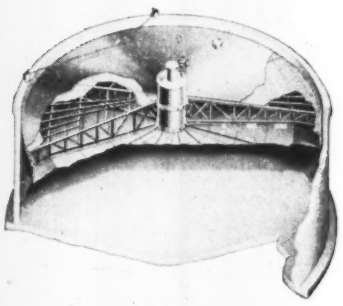

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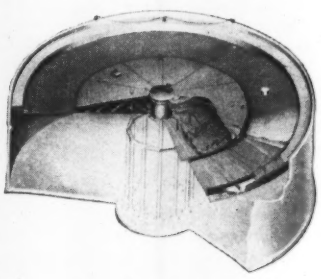

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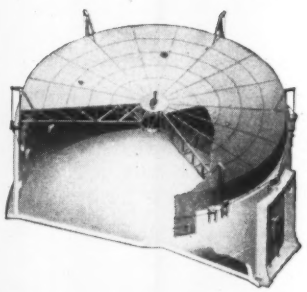

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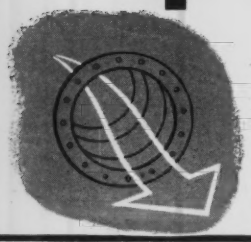

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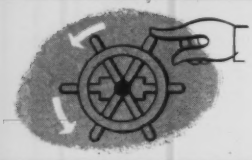

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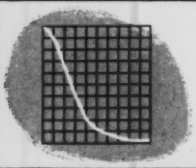
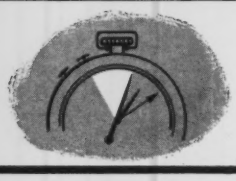


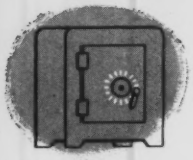
GREATEST INITIAL SHUT-OFF

Rotovalve 55% closed at 25% stroke, and 92% closed at 50% stroke. In comparison, gate valves only 18% closed at 25% stroke and 43% closed at 50% stroke.



MOST CONTROLLED CLOSING TIME

Closing as quickly as one second or as slow as needed. Fast initial closing limits reversal of flow.



MOST POSITIVE CLOSING

Drop-tight, positive closing. Self-purging, monel-to-monel seating. Pressure-tight bolted head, stuffing box, and machined and lapped seats.

In addition to all these features typical of SMS engineering, Rotovalves have a flexibility that makes them suitable for any type of operation, any method of control, or any sort of location.

For detailed information about SMS Rotovalves, Ball or Butterfly Valves, see our local representative or write to the S. Morgan Smith Company, York, Pa.

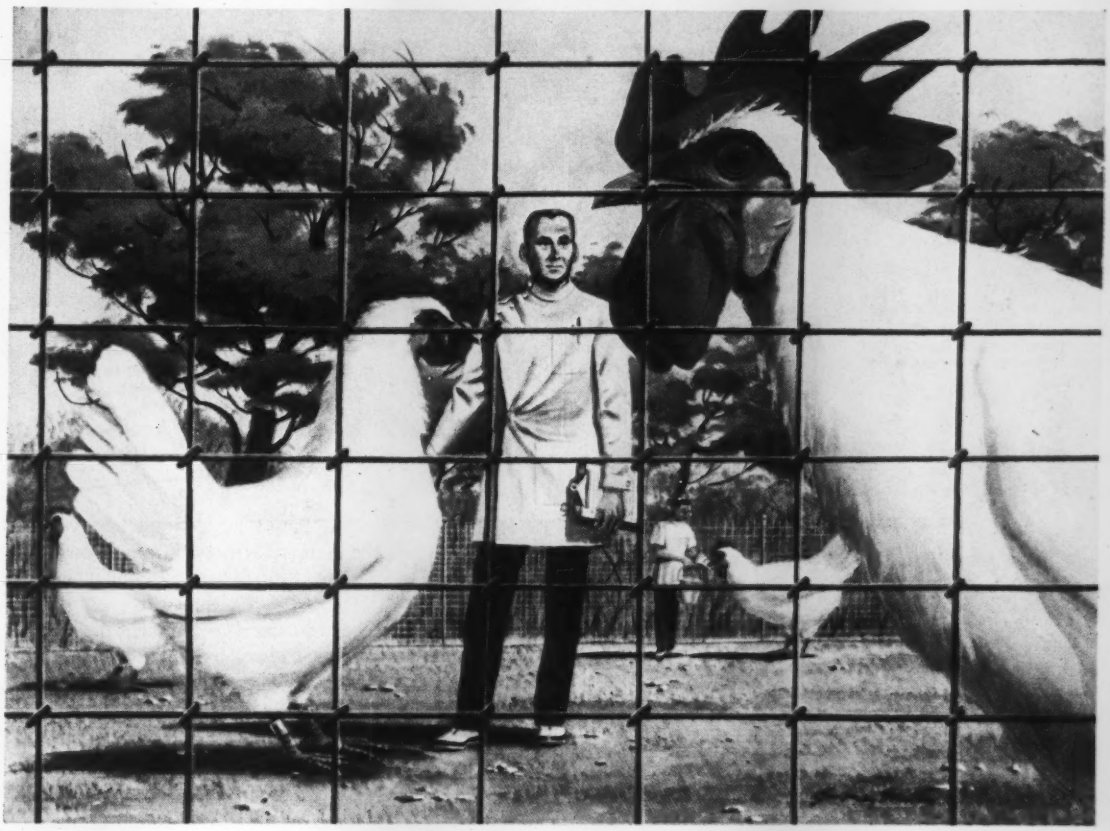
S. MORGAN SMITH

AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO

HYDRAULIC TURBINES · GATES & HOISTS · TRASH RAKES · PUMPS · ACCESSORIES

HYDRODYNAMICS

ROTOVALVES · FREE DISCHARGE VALVES · BALL VALVES · CONTROLLABLE-PITCH SHIP PROPELLERS · BUTTERFLY VALVES



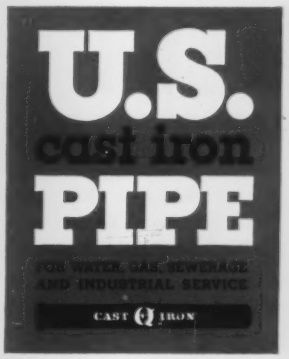
By changing the character of hormones and genes science may increase tremendously the size of fowl and domestic animals . . . put more meat at less cost on the American table.

100 years from now...

WE MAY RAISE CHICKENS AS BIG AS OSTRICHES!

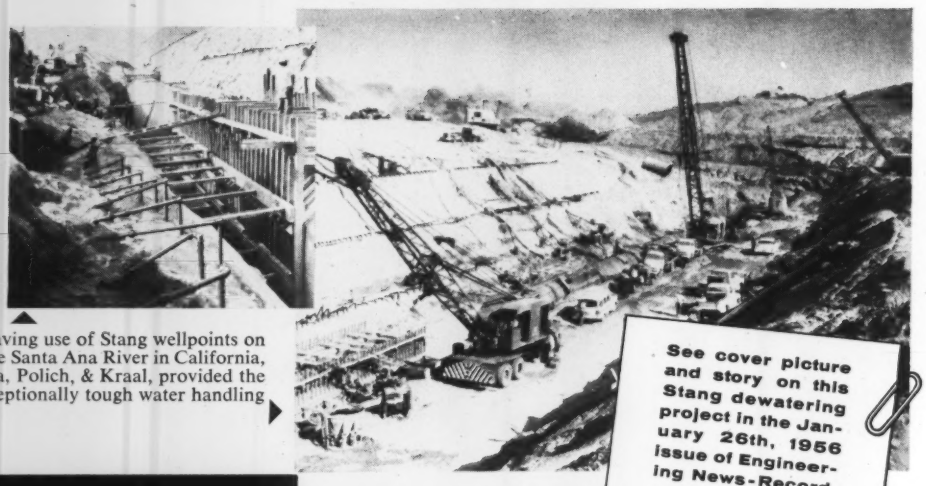
How will we live, eat, travel in the future? Even scientists must include some guesswork in their predictions of the marvelous things to come. But one thing seems certain—water and gas will still be carried by the dependable, long-lasting cast iron pipe laid today. Here's proof! More than sixty American cities are still being served by cast iron water and gas mains over a century old. And today's modernized U. S. Pipe...centrifugally cast, quality controlled . . . is even stronger, tougher, and more durable.

U. S. Pipe is proud to be one of the leaders in a forward-looking industry whose service to the world is measured in centuries.



U. S. PIPE AND FOUNDRY COMPANY, General Office: Birmingham 2, Alabama

A WHOLLY INTEGRATED PRODUCER FROM MINES AND BLAST FURNACES TO FINISHED PIPE.



This time and money-saving use of Stang wellpoints on a pipeline crossing of the Santa Ana River in California, for contractor Ukropina, Polich, & Kraal, provided the ideal solution to an exceptionally tough water handling problem.

See cover picture and story on this Stang dewatering project in the January 26th, 1956 issue of Engineering News-Record.

Only STANG

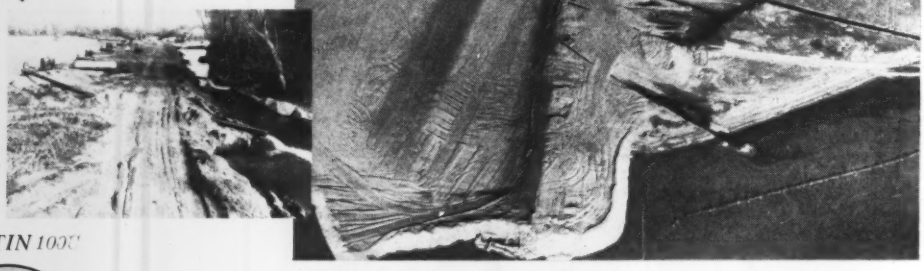
OFFERS EVERY TYPE OF DEWATERING EQUIPMENT *—ANYWHERE, ANYTIME!*

Turbine—Jetting—Wellpoint—Pumps and Systems. Stang's Nationwide Depots stand ready to "bail you out" on a moment's notice

STANG offers the best equipped, most comprehensive dewatering service in the industry. *Any* type of equipment necessary for the dewatering of *any* type job is immediately available in *any* part of the country.

This *tailor-made* service is available as a complete engineering package, handling every detail from start to finish. It is also available on an equipment rental or outright sale basis. Either way, you are assured of the *absolute tops* in water handling. On your next job where a water problem is encountered, *call in a Stang representative*. You'll be amazed at how quickly, efficiently and economically a no-obligation analysis and recommendation is arrived at.

Stang won a race against the Rio Grande River for contractor D. D. Skousen and Son, of Albuquerque, New Mexico, with this deep well turbine installation on the Rio Grande at the Atrisco Syphon jobsite in Albuquerque. With sub-grade 48′ below the ground water table, 10 pumps provided 800′ of dry sub-grade in a few weeks!



WRITE FOR BULLETIN 100

Putting water in its place

STANG ... *anyplace!*

562

JOHN W. STANG CORPORATION

Engineers and Manufacturers of Unwatering Equipment, Wellpoint and Pumping Systems
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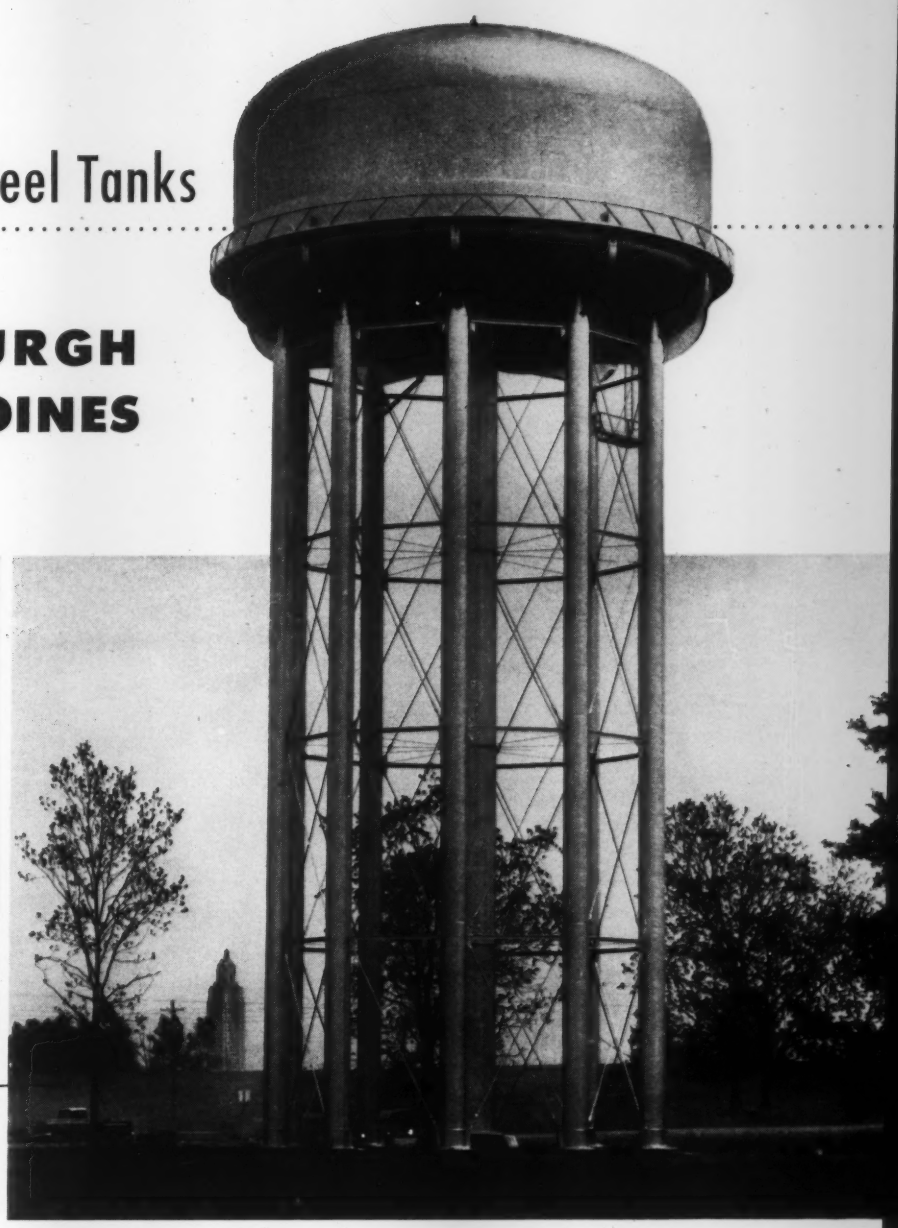
Elevated Steel Tanks

by

PITTSBURGH • DES MOINES



Symbols of service in Louisiana

Symbols of service to the people . . . in the left distance, the tower of Louisiana's beautiful State Capitol at Baton Rouge, and in foreground, the handsome PDM Steel Elevated Tank just completed for Port Allen, La. • Dependable water service at uniform pressures round the clock is assured by the million-gallon capacity of the Radial Cone tank, elevated on a tower 125 ft to bottom. The tank diameter is 71 ft, with 35 ft headrange. Let us send you our latest Modern Water Storage Catalog.

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LOS ANGELES (48) . . . 6399 Wilshire Blvd.
DES MOINES (8). . 971 Tuttle Street
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MADRID, SPAIN . . . Diego DeLeon, 60

PDM
ELEVATED STEEL TANKS

Just specify

River crossing installation of 16" flexible joint cast iron pipe for sewer construction at Salina, Kansas.

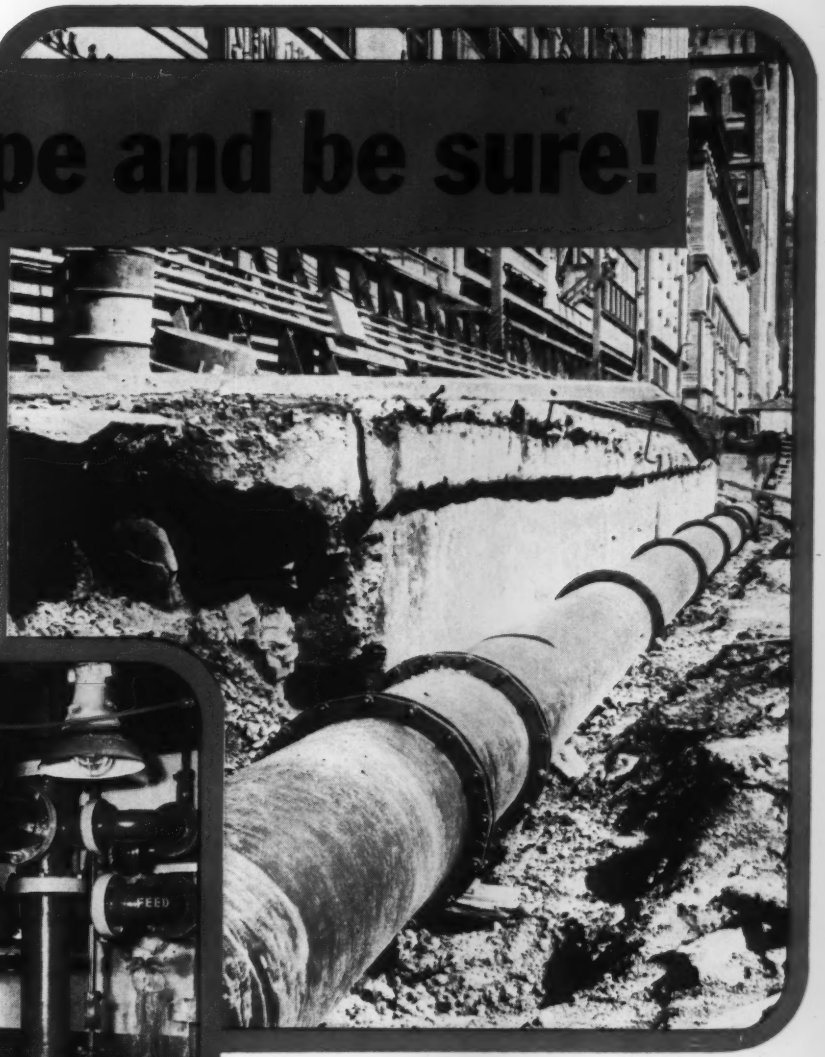
For permanent construction, it makes sense to specify pipe with a proved record of long life. Cast iron mains are in their *second century* of service in over sixty American cities. Yet these tough old mains were built with pipe made by rule-of-thumb and with rudimentary knowledge of metallurgy. Today's modernized cast iron pipe, centrifugally cast and quality controlled, is of course tougher, stronger, more durable. You can specify it with confidence. For information, write Cast Iron Pipe Research Association, Thomas F. Wolfe, Managing Director, 122 So. Michigan Ave., Chicago 3, Illinois.

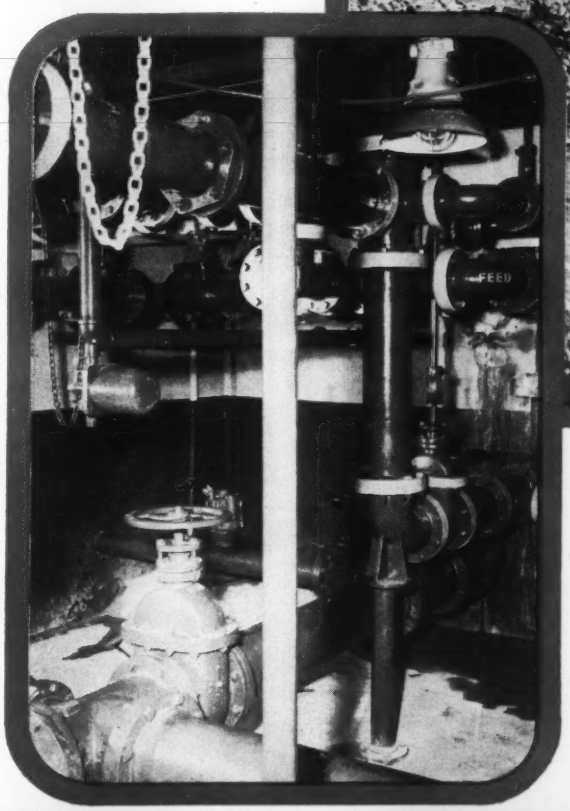
(above)
Four cast iron lines, pulled in pairs across river, being installed for large aluminum producer at Mobile, Ala. (Photo courtesy Aluminum Company of America)

(at right)
Installing cast iron pipe for gas main at Indianapolis, Ind.

CAST IRON PIPE

this pipe and be sure!

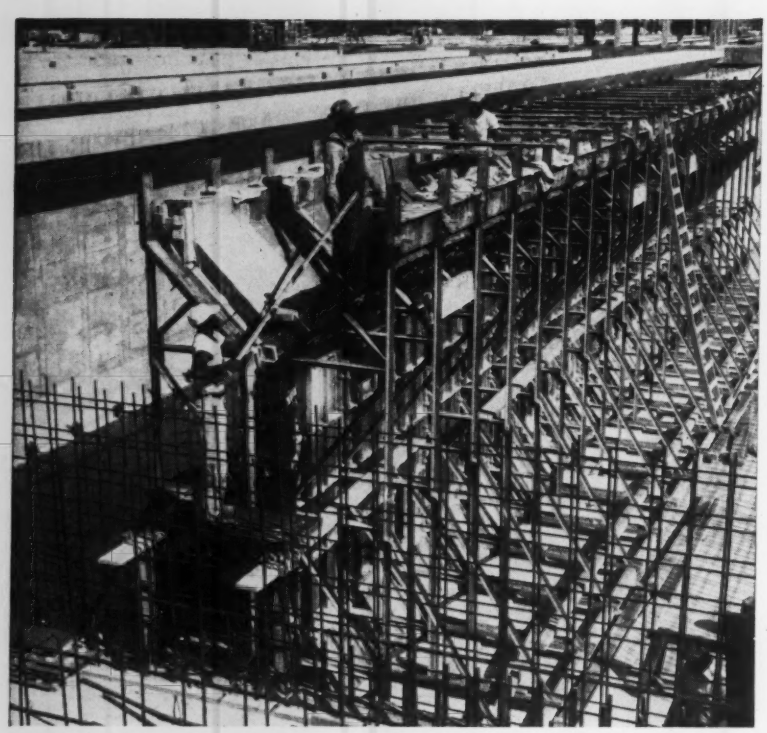




(above)
24" mechanical joint cast iron pipe installed for re-routed water line due to underground garage under Michigan Avenue, Chicago, Ill.

(at left)
Cast iron pipe installation in sewage treatment plant at Dunedin, Fla.

SERVES FOR CENTURIES...



Special Y wall forming system makes for simplified stripping operation. 100% reusability of all materials. Note complete absence of lumber normally required for shoring and bracing on this type of structure.

CUTS MATERIAL COSTS with Pre-Fab Form System on Sewage Plant Job

In the construction of the Miami Sewage Treatment Plant Job the Paul Smith Construction Co., of Miami, Florida chose to use the Uni-Form Panel System in the forming of one million sq. ft. of contact area. The contractor estimated that the use of the Uni-Form System *saved 40 percent in material costs alone.* In addition, faster form erection with fewer men kept the job moving ahead of schedule and reduced estimated labor costs considerably. These fine results were obtained even though this was the contractor's first experience with the Uni-Form Panel System.

This considerable savings in material and labor was realized in spite of intricate Y wall forming and pipe intersections which causes complicated forming problems with conventional forming systems.

Pre-fabricated, ready to use—completely engineered to handle most forming problems, the Uni-Form Panel System provides such advantages as simple assembly—minimum one side alignment and bracing—automatically accurate wall widths—positive internal spreading—faster stripping and maximum re-usage to give the contractor lowest all around form costs.

Y wall trusses designed to member with standard Uni-Form Panels formed a completely automatic system for handling the special forming problems, and were big factors in the economy and speed obtained on the job. Simple assembly of Standard Uni-Form Panels on the trusses eliminated many of the aligning, bracing and spreading problems usually encountered in Y wall construction. In addition to simplified forming the combination system of standard Uni-Form Panels and trusses eliminated many of the problems normally encountered in the stripping of a wall section of this type. The contractor was well pleased with all phases of his forming and stripping operations.

Why not investigate the many advantages the Uni-Form Panel System can bring to you? Write for the Uni-Form Catalog—or better yet, send us a set of plans for an estimate on your next job. Let us prove to you as we did to the Paul Smith Construction Co., that the Uni-Form Panel System can cut your forming costs.

UNIVERSAL FORM CLAMP CO.
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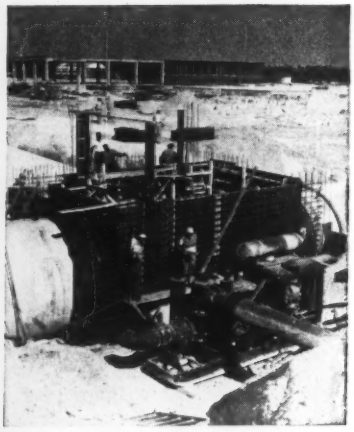
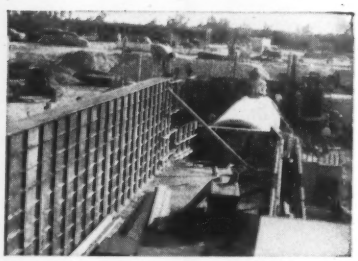
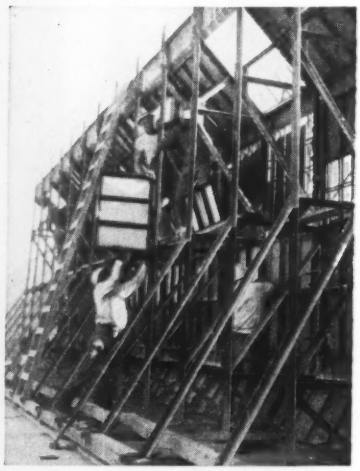


Intricate forming in restricted areas presented no problem. Uni-Form Panels erected aligned and braced one side eliminated difficulties normally encountered in placement of reinforcing steel. Note Uni-Form Panels around large precast pipe.



One side aligning and bracing provides clear unobstructed working areas increasing job efficiency.

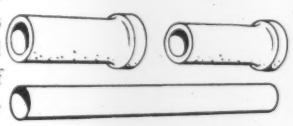


Y wall trusses incorporated alignment, bracing, shoring and scaffolding requirements.

City officials, engineers, contractors will be interested in these . . .

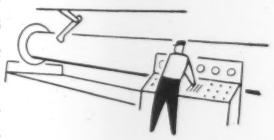
Facts About Steel Water Pipe

COMPARE THE COSTS . . .



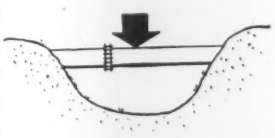
This scale drawing compares a single 40-ft length of steel pipe with two 16-ft lengths of rigid-walled pipe of the same inside diameter. The steel pipe has thinner walls and a smaller outside diameter; weighs only about one-fifth as much per ft of length. Results: the steel pipe costs less to ship and handle; requires a smaller ditch, fewer bell holes, fewer joints—only 132 per mile.

TESTED FOR STRENGTH . . .

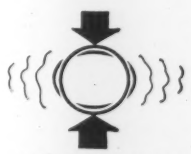


Every length of steel pipe is hydrostatically tested at the shop in accordance with AWWA specifications—usually to double the working pressure. What's more, steel pipe is designed to withstand from 3 to 4 times the working pressure! It safely resists water-hammer, shock loadings and surge.

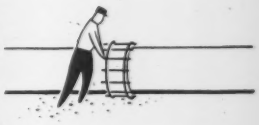
BEAM STRENGTH . . . Steel pipe has the structural strength that is characteristic of tubular steel. It can span long washouts; is often handled in multiple lengths during installation. And steel pipe can stand up under the weight of extremely heavy cover.



RESILIENCE . . . Steel "gives" under stresses that would cause more rigid materials to crack or break. Steel pipe can "absorb" traffic vibration as well as shock due to explosions and earth tremors. Its resilience allows it to transmit much of the strain to the surrounding earth. This is not true of rigid-walled pipe.



LEAKPROOF JOINTS . . .



100 pct bottle-tight joints are a practical reality with steel pipe, whether Dresser couplings or welds are used. Water leakage is prevented; there's no contamination of the contents due to infiltration from without. These joints are quickly made, they're permanent, and they're strong.

CORROSION-RESISTANCE

Modern methods of lining steel pipe with hot-spun coal-tar enamel make it immune to corrosion and incrustation. There is no known time limit to this protection. Many tar-enameled lines have been in service for upwards of fifty years. Coal-tar enamel provides the smoothest surface obtainable, assuring high flow coefficients year after year. Coatings and wrappings protect the pipe exterior from moisture, acids and alkalis.

WIDELY USED . . . Large-diameter steel pipe is the growing choice of planners of municipal and industrial water systems. Some recent users of Bethlehem Steel Pipe are: New York City, New Orleans, Philadelphia, Savannah, Reading, Cincinnati, Atlanta, Omaha, Worcester, Colorado Springs and Boston. Further proof of the superior qualities of steel pipe is its use in thousands of miles of large-diameter gas and oil lines, as well as in high-pressure penstocks throughout the world.

If you would like to have further information about steel water pipe, kindly call or write to the Bethlehem sales office nearest you.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

NEWS OF ENGINEERS

Henry T. Heald, chancellor and president of New York University since February 1952, has resigned this position to accept the leadership of the Ford Foundation as its president. He takes over his new duties on October 1.

William L. Voorduin has joined the Development and Resources Corporation of New York, N.Y., as director of engineering. Mr. Voorduin recently returned from a visit to Iran, and is now organizing preliminary engineering work for the Karun and Karkheh rivers in the Khuzistan Region as part of the assignment recently made to the Development and Resources Corp. by the Plan Organization of Iran. He was formerly chief hydraulic engineer for Gibbs and Hill, Inc., New York, whom he served on many foreign assignments.

Joseph A. Delinks, formerly chief of design with the Corps of Engineers Northern District, Joint Construction Agency in Europe, has been transferred to the Philippine Islands. His new address will be Assistant Chief Engineer OICE, c/o Navy Department, Subic Bay, P. I.

Edward J. Squire, after 46 years as a member of the faculty of the Polytechnic Institute of Brooklyn and head of the Department of Civil Engineering since 1938, will retire September 1. A noted teacher and engineering consultant, Professor Squire participated in the planning and design of many well-known installations, including the Trans-Arabian Pipeline, pumping stations for the war emergency pipelines "Big Inch" and "Little Inch", utilities for the town of Oak Ridge, Tenn., and the Holland Tunnel ventilation buildings in New York.

James O. Jackson, vice-president and director of Pittsburgh-Des Moines Steel Co. is the 1956 winner of the Marston Medal at Iowa State College. The medal is awarded to outstanding engineering alumni of the college. A graduate of Iowa State with a civil engineering degree in 1917, Mr. Jackson has been employed by the Pittsburgh-Des Moines Steel Co. since his graduation. For the past 30 years he has been in charge of all engineering activities of the company. His work has involved the design of many hundreds of elevated steel water tanks, steel bridges, steel buildings, elevated spherical liquid and gas storage tanks, wind tunnels and double-shell insulated low-temperature storage tanks.

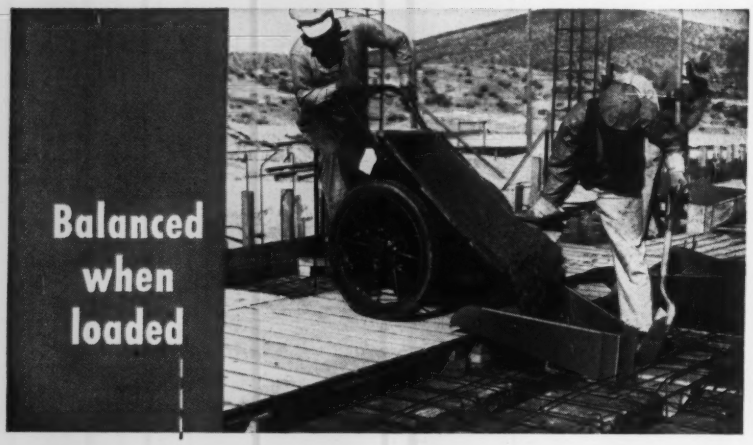
James O. Jackson

Donald Lee Dean, associate professor of civil engineering at the University of Kansas, was recently appointed assistant to the dean of the School of Engineering and Architecture. Dr. Dean joined the K. U. faculty last year after six years as instructor and assistant professor at the Missouri School of Mines.

William E. Willey was recently named as state highway engineer of Arizona. He has been with the Highway Department since his graduation from the University of Illinois in 1932, with time out to serve as a colonel in the Air Force during World War II.

Michael Baker, Jr., consulting engineer of Rochester, Pa., announces the purchase of one of the oldest engineering firms in the United States, the J. Murray Africa Co. of Hungington, Pa. The 135-year-old company will be operated as a division of Michael Baker, Jr., Inc., of Rochester.

GAR-BRO CONCRETE CARTS
INSURE *Full Capacity* LOADS



HANDLES 30% MORE load with half the effort.

LIGHTWEIGHT—¼ to ⅓ lighter than ordinary carts.

ROCKER DUMP type carts are available for handling dry concrete.

HIGH TRAY permits hauling lumber, forms and other materials.

THREE MODELS: Narrow 30" width, 6 cu. ft. cart for easy handling and narrow runways. Standard 35" width, 6 to 8 cu. ft. carts. See your Gar-Bro dealer.

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General Offices: 2415 E. Washington Blvd., Los Angeles 21, California

Ask your dealer for the Gar-Bro Manual . . .

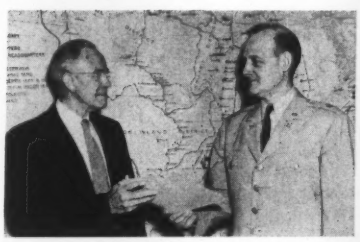
GAR-BRO *the world's most complete line of* Concrete Handling Equipment

Joseph P. Blundon, president and chairman of the executive committee of the Farmers and Merchants Bank of Keyser, W. Va., has been appointed a member of the Small Business Administration's National Board of Field Advisers. This advisory group has been of great assistance in developing programs to help expand and strengthen the nation's industrial economy.

Joseph F. Foley, president and treasurer of the Callan Construction Corp., highway and general contractors of Bristol, R.I., was elected president of the New England Road Builders Association at its annual meeting in Boston. His election culminates 16 years as a director and vice-president of the organization.

Joe T. Fox has resigned his position as right-of-way engineer for the City of Dallas to assume new duties as an assistant trust officer for the First National Bank in Dallas. Mr. Fox is a recent civil engineering graduate of Southern Methodist University.

George L. Jackson, chief engineer of the Illinois State Toll Highway Commission, was recently installed as president of the Western Society of Engineers at its annual dinner meeting in Chicago.



A. Frederick Griffin, special engineering consultant in the North Central Division, Corps of Engineers, is presented with a Department of the Army Sustained Superior Performance Award by Brig. Gen. Paul D. Berrigan, Division Engineer, in ceremonies at the Division Office in Chicago observing the 181st anniversary of the Corps of Engineers. The Performance Award Certificate carries with it a cash award of $300 and Mr. Griffin also receives a Service Emblem in recognition of 30 years of continuous service with the Corps. Mr. Griffin's principal duty is the overall planning for the St. Lawrence Seaway project including review and coordination of designs, plans and specifications.

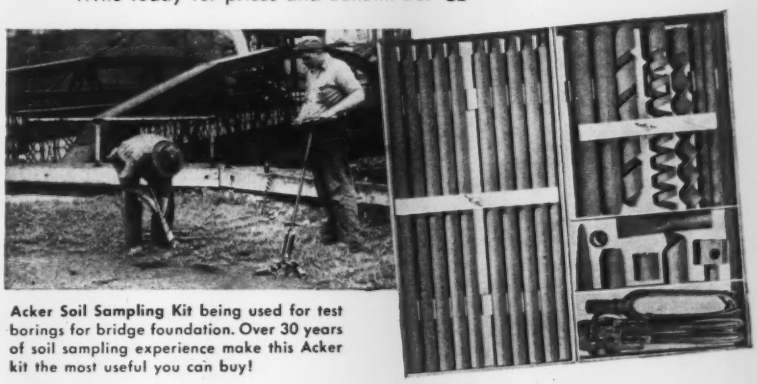
(*Continued on page 20*)

DON'T GUESS!

use an ACKER SOIL SAMPLING KIT for accurate sub-surface information

With accurate sub-soil information, *you avoid* costly trouble later on. And, what better way to get this information than with a portable, easy to use Acker Soil Sampling Kit. For here is a versatile collection of twelve soil sampling tools packed in a handy steel kit that can be carried in any car.

Write today for prices and Bulletin 26. CE



Acker Soil Sampling Kit being used for test borings for bridge foundation. Over 30 years of soil sampling experience make this Acker kit the most useful you can buy!

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a complete line of Diamond and Shot Core Drills, Drilling Accessories and Equipment

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News of Engineers

(*Continued from page 19*)

James T. Doyle has been named steel framing distributor for the Penn Metal Co., Inc., of Parksburg, W.Va. Mr. Doyle, former manager of the lightsteel division of Macatee, Inc., has formed a firm known as the Jim Doyle Co., with offices at 2907 Holmes Road, Dallas.

William R. Ganser, Jr., has joined the staff of the American Institute of Timber Construction in Washington, D.C., as structural engineering assistant. He will assist in carrying out the Institute's plans to develop closer liaison with architects, engineers, contractors, technical schools, government agencies, code-writing officials and others responsible for building design and construction. Mr. Ganser had been associated with the Timber Engineering Company in Washington, D.C., for seven years.

W. R. Ganser, Jr.

The professional engineering organization, **H. E. Bovay, Jr.,** consulting engineers, of Spokane and Houston, has recently opened its Southeast office in Baton Rouge, La., at 1742 North 21st Street.

George E. Madsen, of Claremont, Calif., sanitary engineer reserve officer with the Washington headquarters of the Public Health Service, Department of Health, Education, and Welfare, has been assigned to the Arctic Health Research Center in Anchorage, Alaska. He has been a commissioned officer on active duty with the Public Health Service since July 1955.

Samuel S. Steinberg, dean of the University of Maryland College of Engineering, has been reappointed for a 5-year term as a member of the State Board of Registration for Professional Engineers and Land Surveyors. He is chairman of this Board and has served on it for three terms.

Malcolm S. Spelman, specifications engineer for the Port of New York Authority for over 20 years and more recently associated with the consulting firm of Howard, Needles, Tammen & Bergendoff, has joined the consulting firm of Gussow & Skidmore, electrical and mechanical engineers, to form the new firm of Spelman, Gussow & Skidmore, Consulting Engineers, 50 Church Street, New York, N.Y.

Theodore M. Kuss was recently made an associate in the firm of Moran, Proctor, Mueser & Rutledge of New York, N.Y. He was formerly project engineer with this firm.

George E. Shafer is new vice-president in charge of engineering of Armco Drainage & Metal Products, Inc., Middletown, Ohio. Mr. Shafer joined the Armco Culvert Manufacturers Association in 1925. When this group merged with Armco Drainage, he was appointed sales engineer in the culvert and pipe department of Armco. He was promoted to chief engineer in 1950. His new duties will include supervising the development of new products and improvement and seeking of new applications for present products.

George E. Shafer

George C. Ernst has resigned from the chairmanship of the civil engineering department of the University of Nebraska in order to devote full time to teaching and research at that institution. He is currently in charge of an investigation of reinforced concrete in the plastic range of loading, sponsored by the National Science Foundation, the University Research Council, and the University Foundation.

O. H. Ammann, Honorary Member of the Society and New York City consultant, recently received the honorary degree of doctor of science from the Polytechnic Institute of Brooklyn.

YOU MUST READ THIS!

Before you pay out another costly plumbing bill—

Chicago, **August 2nd**—Here is a new Unit designed to clean out the most stubborn drain and sewer stoppages in a matter of minutes. Now you can clean out clogged-up **Toilets, Sinks, Urinals, Flooded Basements** up to 100 feet. Yet this new Rodding Tool is easy to operate as the Patented rod is whirled down the pipe removing Roots, Grease, Rags, and Sand—

Why wait for trouble, but most of all why pay out a costly Repair Bill when you can Rod-it-yourself! **This new unit pays for itself in one job** and is offered on a 30-day Free Trial Plan to prove it. Tear this ad out now—lest you forget—and write for FREE BOOKLET. Here's Good News for Every Office Building, Contractor, Factory, Apartment, Institution, and Home.

WE OFFER 30 DAYS FREE TRIAL TO PROVE IT!

Now, with the New Miller Triple-Action Grease and Root Cutter you can clean out roots, grease, glass, heavy obstructions up to 500 ft. No need to remove wall, dig up lawn—Saves Costly Repair!

ELECTRIC UNIT cleans "3 to 12" Pipe—500 feet.

OBEY THAT URGE. WRITE NOW FOR FREE BOOKLET.
No salesman will call.

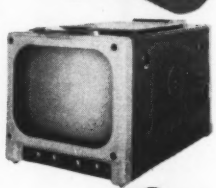
But now we ask—what is it worth to you **WHEN ITS COST IS LESS THAN THE PLUMBING BILL?** We sell Rodding Tools and Electric Root Cutters. **For your own good—Don't Wait!** Write this moment for Free Booklet. The money these Tools save will amaze you! No agent will call. Mail coupon or Postcard . . . Right now. Chicago phone KIldare 5-1702.

MILLER SEWER ROD, Dept CE. 4642 N. Central Ave,, Chicago 30, Ill.
Please send FREE BOOKLET on Rodding, I am not obligated.
NAME . . . . . .
STREET . . . . . CITY . . . . . STATE . . . . .

SUPERSENSITIVE ELECTRONIC EQUIPMENT
Since 1926

NEW . . . BLUDWORTH

MARINE-GPL TV CAMERA



For salvage, marine exploration and channel inspection to 180 foot depths. Diver holds camera (approx. 1½ lbs submerged), relays continuous picture to Monitor screen on boat or land. Closed circuit TV specially designed for underwater use. Approx. *$4,000.*

UML 20 UNDERWATER METAL LOCATOR

Salvage sunken vessels, cables, pipes. Pinpoints ferrous and non-magnetic metals in fresh or salt water, depths to 160 feet. Easy-to-read "MEMETER." Only 1½ lbs submerged. $545 net, including batteries, immediate delivery.

PRECISION DEPTH RECORDERS

For underwater survey, dredging and oil exploration. New improved models—3-scale ranges 2 to 60/120/180 feet up to 8-scale model with ranges 2 to 60/120/180/240 feet and 1 to 60/120/180/240 fathoms. Built-in power supply, correction controls. Accuracy ±3 inches.

Other Precision-Built Products
RADAR • RADIOTELEPHONES • "POWER DIVER"
Brochures mailed on request All prices F.O.B. New York

BLUDWORTH MARINE

Division of KEARFOTT COMPANY Inc.
92 Gold Street, New York 38, N. Y. A SUBSIDIARY OF GPE

Chester P. Siess (left), research associate professor of civil engineering at Illinois University, receives 1956 Concrete Reinforcing Steel Institute Award won by him and by Nathan M. Newmark, research professor of structural engineering at Illinois Univ., in recognition of their outstanding contributions in the field of reinforced concrete research. Prof. H. J. Gilkey (right), of Iowa State College, makes presentation at 32nd annual C.R.S.I. meeting at White Sulphur Springs, W. Va. Dr. Newmark was recently named to be head of civil engineering department at Illinois University, effective September 1.

Carl B. Johnston, former staff engineer for the Los Angeles Regional Water Pollution Control Board, Los Angeles, Calif., has joined the staff of Pomeroy and Associates, consulting civil and chemical engineers of Pasadena, Calif. Mr. Johnston will deal with industrial water pollution control problems and design of facilities for handling sewage, industrial waste, and refuse disposal.

Lester M. Sanford, structural engineer of Rochester, N.Y., announces that his office address has been changed to 315 Alexander Street in that city. Mr. Sanford specializes in buildings, bridges, and heavy machinery designs, plans, specifications, estimates and reports.

John M. Rollins has been appointed chief safety engineer of Ethyl Corporation's Southern region, with headquarters in Tulsa, Okla. Mr. Rollins has been associated with Ethyl since 1933, and for the past four years has been regional safety engineer in Baton Rouge.

F. T. Norcross, president of Associated Engineers Inc., Washington, D.C., firm of land planning consultants and engineers, has been retained as planning consultant for the projected $100,000,000 Thorncliffe Park development in Toronto, Ontario. Located on a 388-acre river site in the heart of the city, the development is described as "a midtown Manhattan of skyscrapers."

Stanley M. Dore has been appointed chief engineer of the New York City Board of Water Supply, effective June 1. He has held the position of deputy chief for nearly four years, and replaces **Karl Kennison.** In private practice in Rowayton, Conn., Mr. Kennison was reappointed consultant to the Board, which he served from 1939 to 1952.

(Continued on page 90)

Photos courtesy of Columbus Dispatch

Kinnear Rolling Doors

Here's double-barreled doorway efficiency and protection!

A Kinnear Steel Rolling Door and Rolling Grille in the same opening! Both open *upward,* coiling into a small space above the doorway.

When the grille alone is closed, it bars intruders without blocking light, air, sound, or vision.

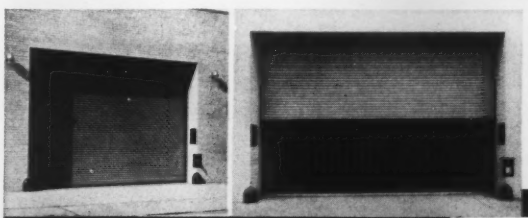
When the Kinnear Rolling Door is closed, its rugged curtain of interlocking steel slats gives extra protection against weather, intrusion, and fire.

With both door and grille closed, a *double* steel barrier repels vandals, thieves, or troublemakers.

Separately or together, the door and grille can be raised or lowered by push button. When opened, they clear the entire doorway, and stay completely out of the way. Whether opened, closed, or in action, they never take up usable floor, wall or ceiling space.

For safety, eye-appeal, efficiency and protection at doorways of any size, in new or old buildings, with any architecture or building material, you get top value with Kinnear Rolling Doors. Their *coiling upward action* has been proved by more than half a century of time-saving, space-saving, low-cost performance. Write today for full information.

HEAVILY Galvanized for lasting protection, Kinnear Steel Rolling Doors are thoroughly coated with 1.25 oz. of pure zinc per square foot of metal (ASTM Standards) then treated with Kinnear's special Paint Bond to assure quick firm full-coverage of field applied paint.



The neat, trim appearance of Kinnear Rolling Doors and Grilles is evident in the new and modern building housing the newspaper printing presses of the Columbus (Ohio) Dispatch.

KINNEAR ROLLING DOORS
Saving Ways in Doorways

The KINNEAR Mfg. Co.
FACTORIES
1080-90 Fields Avenue, Columbus 16, Ohio
1742 Yosemite Ave., San Francisco 24, Cal.
Offices and Agents in All Principal Cities

"New Bonus-Powered International® give work-speeding capacity..new

To grade the Indian Hills home project site near Sioux City Country Club, Contractor William C. Grady, LeMars, Iowa, must move 132,000 yards of dry clay—must make cuts 35 feet deep, and fills 25 to 40 feet deep. Two new International 55 Payscrapers, push-loaded by TD-18 crawler, replaced two crawler-scraper units, with these big results:

"The two new 55 Payscrapers have jumped our daily yardage 1500 yards—*80% or better*—compared to crawler-scraper units replaced," reports Owner Grady. "The new 55's have proved that even on very short hauls, their rubber-tired speed pays off. Now, our same

"Years of excellent performance from our International crawler fleet, backed by fine service, helped our company grow to a fleet of 11 International crawlers," states Nor-Vel Construction Co., Ferguson, Mo. Here's two of their TD-24's, helping move wet clay on a large Black Jack, Mo., housing job.

"The new TD-9 has got it—more reserve power that speeds the job," states Owner Gene Elkins, Pontiac, Mich., of his new bonus-powered International crawler—shown doing "clean-up" and grading on a 306-home project near Detroit. "It's really got zip—dozes dirt extra fast in second gear."

"Short-haul yardage soars"

outfits . . . . operating ease"

manpower moves practically double our former yardage. Loading averages 42 seconds in dry, hard-packed clay. Easy operation and plenty of power make new Payscrapers the operators' favorites."

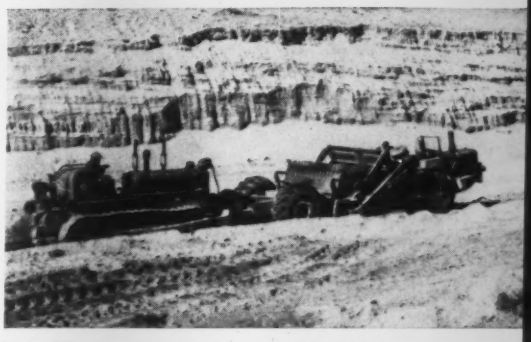
Why not try a bonus-powered International outfit on your job? See your nearby distributor for a demonstration!

See you at the ROAD SHOW— CHICAGO Jan. 27 to Feb. 4, 1957

"I can rip up concrete with pry-action breakout—without strain on the crawler," declares J. E. Johnson, Knoxville, Tenn., of his new bonus-powered TD-9 International Drott Skid-Shovel. "Best grading loader I've operated. Has no-strain steering, fine job vision."

4 new TD-24's. "Work ability and distributor service were major factors when buying 4 new TD-24's," says Tony Petitto, Jr., Byron Construction Co., Clarksburg, W. Va. These tractors replaced 4 competitive crawlers. A fifth TD-24 on this stripping job has worked 7500 hours.

"95% International since 1940—"
"Loose, dead sand—almost impossible to load—yet we average 2500 yards daily where I believe other scrapers would fail miserably," reports Contractor N. V. Lamb, Lusk, Wyo. "The powerful International TD-24 Torque Converter and easy-loading 55 Payscrapers are giving high output in tough material."



"Since 1948, preferred International engines"
"With only routine care our International machines stand up," state Howard and Dorsey Hall, Hall Sand & Gravel, Denver, Colo. Their new TD-14 (142 Series) is shown stockpiling sand. Their International fleet includes a TD-14 Skid-Shovel, four power units!

INTERNATIONAL HARVESTER

INTERNATIONAL® Construction Equipment

International Harvester Company, 180 N. Michigan Avenue, Chicago 1, Illinois

A COMPLETE POWER PACKAGE INCLUDING: Crawler, Wheel, and Pipe-Beam Tractors . . . Self-Propelled Scrapers and Bottom-Dumps . . . Crawler and Rubber-Tired Loaders . . . Off-Highway Trucks . . . Diesel and Carbureted Engines . . . Motor Trucks

GOING IN...

...a long-term community investment

It's Transite Ring-Tite Pressure Pipe

• Transite® Ring-Tite® Pressure Pipe is a community investment that pays off year after year!

Its remarkably high flow characteristics protect that investment by keeping maintenance and pumping costs at a minimum during its long service life.

Corrosion Resistant

Transite Pipe is strong, durable, and highly resistant to corrosion. And it is immune to tuberculation, the form of interior corrosion that chokes the flow and increases pumping costs. Transite cannot tuberculate, thus its original high flow capacity is maintained, and pumping costs are kept at a minimum year after year.

The Ring-Tite Coupling, with rubber rings compressed and locked in place forms a joint that is tight yet flexible. Rings cannot blow out, and the automatic separation of the pipes within the coupling helps to relieve line stresses.

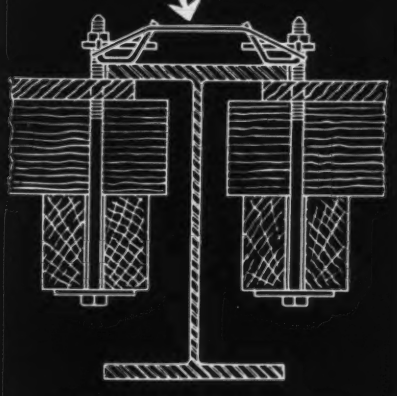
For further information about Transite Pressure Pipe and the Ring-Tite Coupling, write for Booklet TR-160A. Address Johns-Manville, Box 60, New York 16, N.Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville TRANSITE PRESSURE PIPE

WITH THE RING-TITE COUPLING

Faster Adjustment from TOP of Deck



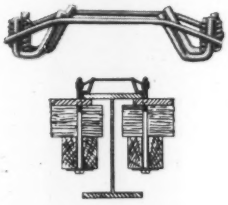
TOTAL SAFE LOAD ON BOTH COIL BOLTS IS 10,000 LBS., OR 5,000 LBS. PER BOLT

..WHEN HANGING FORMS WITH SUPERIOR PLATE HANGER FRAMES

With Superior Plate Hanger Frames the installation and necessary adjustment to bring the deck forms tight against the flange are from *above* the deck. Coil Bolts are passed through and secured from above with coil nuts. Bolts are easily removed without binding because, (1) nuts are square and will not turn; (2) embedment of the bolts in the concrete is at a minimum since the plate is only ½" above the flange.

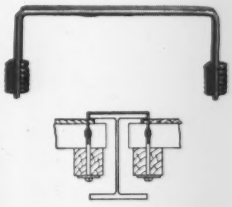
FOUR OTHER SUPERIOR WAYS TO HANG FORMS FROM STEEL BEAMS AND GIRDERS ON BRIDGE SUPERSTRUCTURES

STANDARD COIL HANGER FRAME



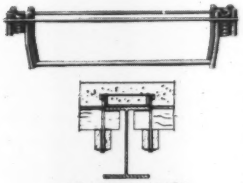
When hanging forms where specifications do not permit any hanger wire to be exposed after stripping, use Superior *Standard* Hanger Frames. Detail at left shows their use with double ledgers, ½" coil bolts, and flat washers. Total safe load on both bolts for Type 10M is 10,000 lbs., or 5,000 lbs. per bolt. For Type 6M, total safe load on both bolts is 6,000 lbs., or 3,000 lbs. per bolt.

COIL BEAM SADDLE



On jobs where hanger wires may be cut after stripping the forms, use Superior Coil Beam Saddles. The Coil Bolts allow for any variation in lumber and flange thickness and tightening the bolts pulls the forms tightly against the flanges. Forms are easily stripped. Safe load is 6,000 lbs. per saddle, or 3,000 lbs. for each ½" Coil Bolt. Coil Beam Saddles are also furnished for ¾" and 1" bolts.

SPECIAL HANGER FRAME

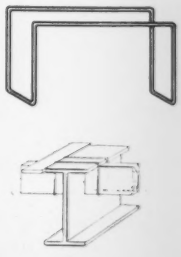


AT LOW HAUNCH

AT HIGH HAUNCH

The design of certain bridge superstructures allows for the permanent deflection of the beams or girders due to the pre-calculated dead load. This deflection is compensated by a concrete haunch of varying depth on the upper flange. Superior *Special* Coil Hanger Frames were developed to meet this field condition, at the same time avoiding any exposed hanger wire. The extent to which the ½" coil Bolts are threaded into the coils allows for these varying haunch depths from maximum to zero. (See detail). Total safe load per frame is 10,000 lbs., or 5,000 lbs. per ½" bolt.

WIRE BEAM SADDLE



Wire Beam Saddles are used to hang centering joists from structural steel beams when the beams are not fireproofed with concrete. On non-fireproofed structures the load is determined by the allowable spacing of centering joists rather than the capacity of the hanger. Available in three gauges and sizes as required. Will carry safely, total loads of 2,500 lbs. to 6,000 lbs. Layouts and estimates will be sent upon receipt of plans or quantities. No obligation.

WORKING PARTS (Bolts and washers) are returnable. Layouts and estimates for Superior Hangers are available without obligation.

SUPERIOR CONCRETE ACCESSORIES, INC.

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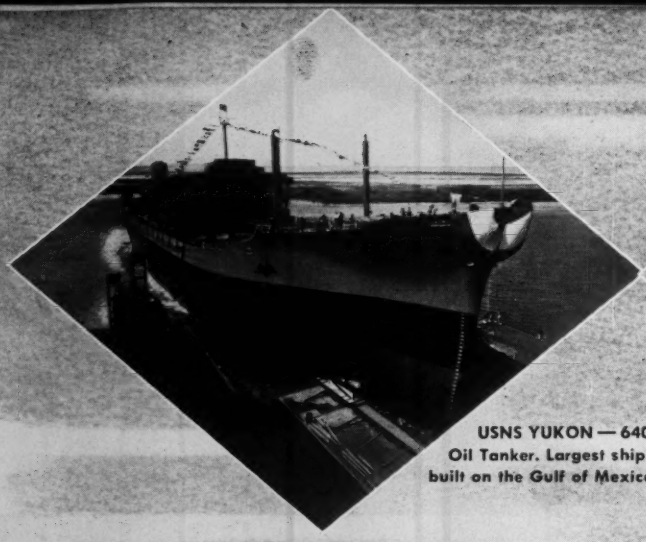
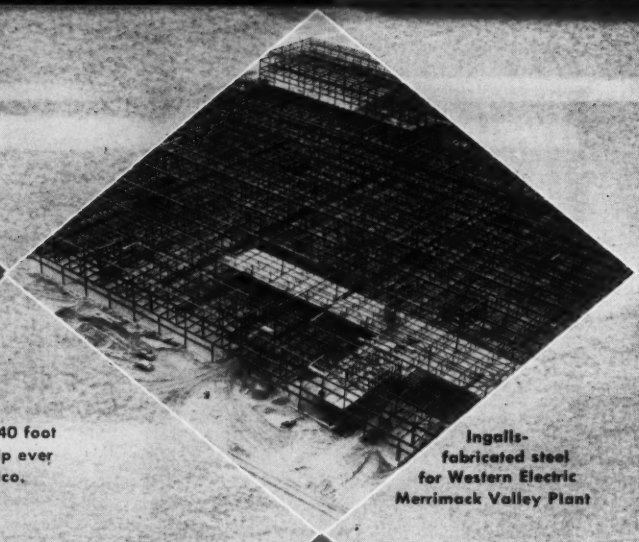


USNS YUKON — 640 foot Oil Tanker. Largest ship ever built on the Gulf of Mexico.



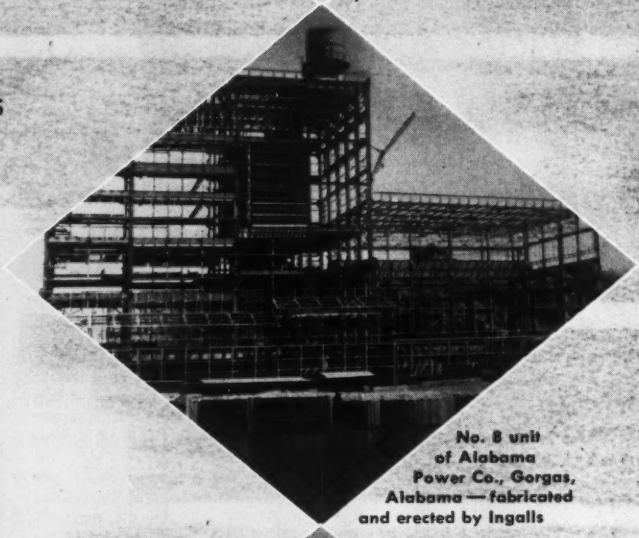
Ingalls-fabricated steel for Western Electric Merrimack Valley Plant

THE **INGALLS** COMPANIES

Ingalls serves both industry and government, in widely separate fields. Ingalls' KNOWLEDGE of all these fields was earned through practical, intense, hard-working years. This knowledge is at your service today.

SHIPBUILDING: The Ingalls Shipbuilding Corporation has built such outstanding ships as the USS *Glacier*, plus many types of tankers, naval vessels, passenger liners, cargo vessels, barges, rigs, towboats and yachts.

STEEL FABRICATION: The Ingalls Iron Works Company is a major nation-wide fabricator of steel for power houses, all types of buildings, bridges, and any special applications.



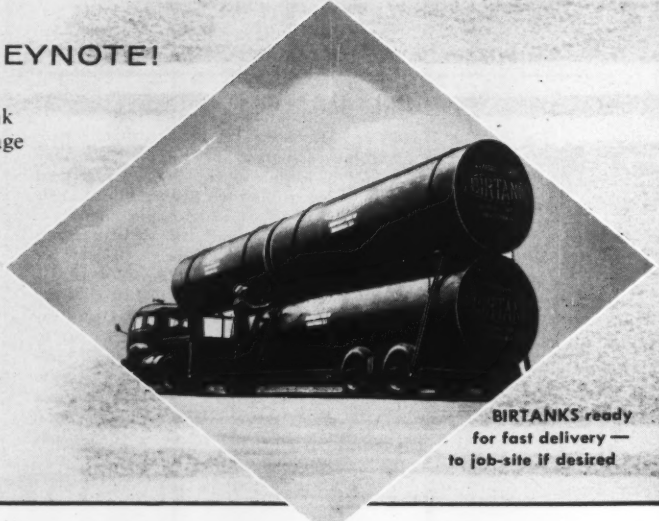
No. 8 unit of Alabama Power Co., Gorgas, Alabama — fabricated and erected by Ingalls

VERSATILITY IS **INGALLS'** KEYNOTE!

PLATE AND TANK WORK: The Birmingham Tank Company, an Ingalls subsidiary, furnishes oil storage tanks, pressure vessels, bins, stacks, rotary kiln dryers, ducts, flues, and blast furnaces; fabricates steel, aluminum, stainless steel, other alloys.

STEEL ERECTION: The Ingalls Steel Construction Company erects structural framework for buildings, power houses, tanks, bins and stacks.

We invite you to write for special literature on any or all of these subjects.



BIRTANKS ready for fast delivery — to job-site if desired

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BIRMINGHAM, ALABAMA

THE INGALLS SHIPBUILDING CORP.
Shipyards: Pascagoula, Mississippi; Decatur, Alabama
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BIRMINGHAM TANK COMPANY
Sales Offices: New York, Chicago, Pittsburgh, Houston, Atlanta, New Orleans, Pascagoula.

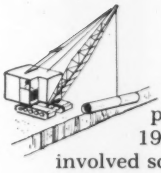
THE INGALLS IRON WORKS COMPANY
Sales Offices: New York, Chicago, Pittsburgh, Houston, Atlanta, New Orleans.

THE INGALLS STEEL CONSTRUCTION COMPANY
Sales Offices: New York, Chicago, Pittsburgh, Houston, Atlanta, New Orleans.

Mare Island
Naval Shipyard is located at Vallejo, Calif.

WATER SUPPLY PROBLEM SOLVED AT...

Vallejo, California



Vallejo, California's severe water supply problem was solved by the installation in 1952 of the Cache Slough Pipeline which involved some 30 miles of pressure conduit.

American Pipe and Construction Co. supplied pretensioned reinforced concrete cylinder pipe from a manufacturing plant at Hayward, California for the pumping line which brings raw water from Cache Slough to the Fleming Hill Treatment plant. Kaiser Engineers did the planning which developed Cache Slough as a new water source and the installation of the pipeline changed Vallejo from a buyer to a seller of water. Glenn Harris was Vallejo's project engineer on the work and is now city engineer for the City of Vallejo.

Vallejo's officials were pleased with the cooperation, service and carefully detailed layout drawings supplied by American's Hayward plant for the Cache Slough project and in 1954 contracted for another 5 miles of 24" American Concrete Cylinder Pipe for the Trans-Vallejo pipeline.

Take advantage of American's 49 years of experience and record of supplying quality products and additional services. On your next project call, or write American for full information.

5604

Concrete pipe for main water supply lines, storm and sanitary sewers, subaqueous lines.

Mail address: Box 3428 Terminal Annex, Los Angeles 54
Main offices and plant:
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On important city streets . . .

(**left**) Heavy-duty plant-mixed Texaco Asphalt pavement on Melrose Avenue, Roanoke, Va. Used by traffic to by-pass the center of the city.

(**right**) U. S. Route 11, near Cloverdale, one of Virginia's principal north-south highways, also paved with heavy-duty plant-mixed Texaco Asphalt.

on busy trunk highways . . .

Virginia's heavy traffic rides on resilient Texaco Asphalt

On many of Virginia's most heavily traveled highways and streets, plant-mixed Texaco Asphalt pavements are demonstrating their rugged durability.

One type of flexible, heavy-duty Texaco Asphalt construction in particular, which serves Virginia's principal east-west truck route, merits special mention. Briefly, a sand-clay subbase is laid on the road and primed with Texaco Rapid-curing Cutback Asphalt. This is followed by a 7½-inch foundation of coarse-graded, plant-mixed Texaco Asphaltic Concrete. The wearing surface is a 1½-inch thickness of plant-mixed Texaco Sand-Asphalt.

This completely flexible, skid-resistant, joint-free pavement is recommended wherever heavy traffic must be served. A fine-aggregate asphaltic concrete surface may be substituted for the sand-asphalt.

Helpful information for the road builder on methods and materials recommended for all types of Asphalt construction is supplied in two free Texaco booklets. Copies may be obtained without obligation by writing our nearest office.

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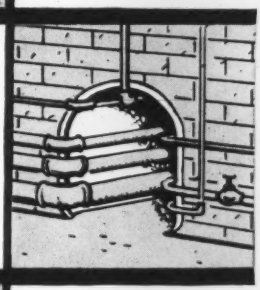
TEXACO ASPHALT

QUICK, LOW-COST ANSWER TO 4 PROBLEMS...

Flat-Base Pipe

PEDESTRIAN UNDERPASS

The practical way to safeguard the lives of adults and children. Especially valuable near schools and playgrounds. Also helps to maintain an even flow of street-level traffic.

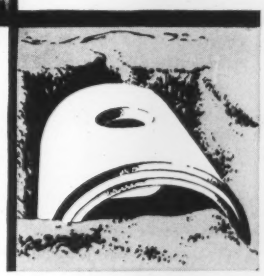


UTILITY GALLERY

Carries steam pipes, gas mains, electrical cables and telephone lines with ample room for workmen to make repairs. Flat-Base Pipe is also used for culverts and cattle passes.

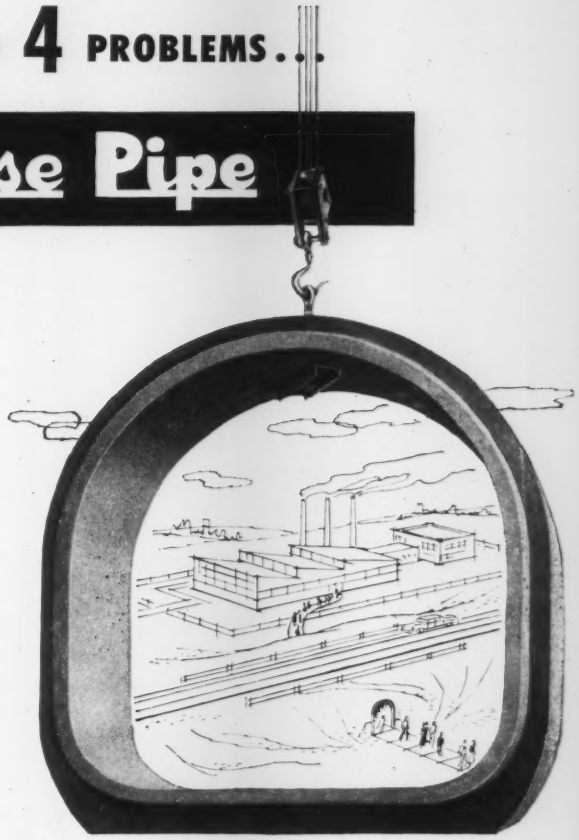
CATTLE PASS

Eliminate the hazards of road level crossings to lives and livestock with Flat-Base underpasses. Reinforced concrete Flat-Base Pipe can be jacked under railroads and highways without disturbing traffic.



UTILITY MANHOLE

Manholes for utility companies have often been built with Flat-Base Pipe in less than four hours. This eliminates needless traffic delay and reduces labor costs to a minimum.



Save as much as *30%* in the construction of pedestrian underpasses, culverts, utility galleries and manholes—with pre-cast Flat-Base Pipe. You can place and cover from 52 to 100 feet of Flat-Base Pipe in a single day. No forms to construct . . . no steel reinforcing to position . . . no concrete pouring. Can be jacked through old construction or laid in new fills. Joints are tongue and grooved and can be made watertight with rubber gaskets. Available now, in a wide variety of standard sizes.

Our technical staff will be pleased to assist you with your pipe problems.

Write for free, illustrated folder on money-saving Flat-Base Pipe.

AMERICAN-MARIETTA COMPANY
CONCRETE PRODUCTS DIVISION

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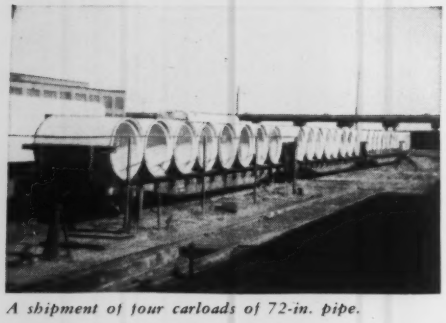
Tellyer Concrete Pipe Co. | American-Marietta Company of Pennsylvania

S-curve section of 72-in. concrete pipe in place.

DENVER'S MOUNTING WATER NEEDS SUPPLIED WITH 27,000 FEET OF *CONCRETE PIPE*



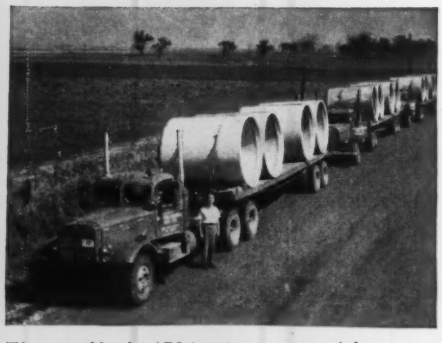
A shipment of four carloads of 72-in. pipe.

The Denver, Colo. Water Board has made available an extra 19,400 acre-feet of water per year for the city's growing needs with its St. Louis Creek Collection System.

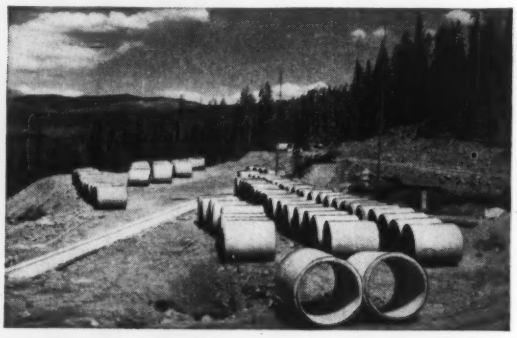
The project, 80 miles west of Denver, required 27,000 ft. of concrete pipe 30 to 72 in. in diameter. Inasmuch as there was no head on these lines, reinforced concrete sewer pipe, ASTM Specification C-75, was used.

Like Denver, many other cities are using concrete pipe to supply their ever-mounting water needs. That's because concrete pipe water lines provide maximum capacity plus great strength and extra long life. No tuberculation or incrustation difficulties lower their hydraulic efficiency. The final result is true ***low-annual-cost*** water line service.

PORTLAND CEMENT ASSOCIATION
33 West Grand Avenue, Chicago 10, Illinois
A national organization to improve and extend the uses of portland cement and concrete . . . through scientific research and engineering field work



Three truckloads of 72-in. pipe enroute to job.



Contractor's pipe storage yard at the job site.

do you know that

The capacity of the Panama Canal is being increased? Simple improvements now under way will give the Canal about 25 percent greater capacity during its periodic overhauls—that is, will permit from 30 to 49 lockages a day instead of 24. Normal Canal capacity is 54 lockages a day. The project is described by a Panama Canal Company official in an article in the September issue.

Solid asphalt can be hauled by pipeline? Construction of a 71-mile pipeline to transport gilsonite slurry over Baxter Pass in the Rocky Mountains is planned by the American Gilsonite Company. Traversing some of the most rugged terrain in the country, the 6-in. pipe will pump the slurry from near Bonanza, Utah, to the company's gasoline and coke plant near Grand Junction, Colo. The line will be carried on a 600-ft suspension bridge over White River Canyon and on a 700-ft bridge over Evacuation Wash, and will follow the grade of an abandoned narrow-gage railroad through Baxter Pass.

The first nuclear reactor for industrial research is now in operation? Armour Research Foundation has this 50-kw unit. The cost ($700,000) is being shared by twenty-four companies, who are having their first chance to conduct nuclear research without security restrictions.

We have one hundred times more government-supported engineering research than Great Britain? This is what British expert Donald F. Galloway, research director of the Production Engineering Research Association of Great Britain, told members of the ASME at their semi-annual meeting in June. Such research in British universities, he said, "probably does not exceed $700,000 per annum, compared with over $70,000,000 spent by the United States Government." Dr. Galloway also pointed to last year's $5 billion total for our research and development in comparison with about $700 million spent in Great Britain.

Civil engineers are still in great demand? Nearly 30 percent of the major firms in the country with job openings in their engineering departments are seeking qualified civil engineers. This is revealed in the 1956 edition of "Engineers' Job Directory," which presents capsule company information on engineering positions open in 236 major firms. Of these, 66 indicate they want civil engineers. Copies of the directory may be purchased from Decision, Inc., 1483 First National Bank Bldg., Cincinnati 2, Ohio, at $3.25 a copy.

Construction continues to be one of the more hazardous industries? In a summary of 1955 industrial accidents, the National Safety Council reports that there was a 12-percent increase in frequency rate of construction accidents and a 3-percent increase in severity rate over 1954. The all-industry rate for the year shows a reduction of 4 percent in frequency rate and an increase of 2 percent in severity rate.

The Army has developed an Arctic shelter that can be erected in 90 minutes? Seven men are required for the job of assembling this 20 by 48-ft unit of 3-in.-thick plywood panels, which can be dropped from the air in disassembled form. Adopted as an Army barracks, the shelter is capable of withstanding sustained winds of 100 mph and snow loads up to 75 psf. It was developed at the Research and Development Laboratories at Fort Belvoir.

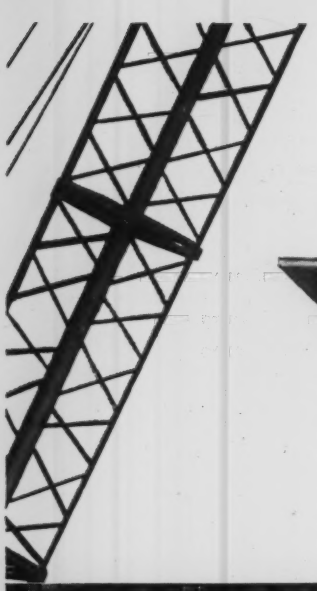
Chicago's water supply is being fluoridated? A fluoridation plan for the city, put into effect this spring, includes 51 suburban areas that purchase water from Chicago. Some 4,300,000 persons are affected by the plan.

A special issue is planned for October? A group of significant Pittsburgh Convention papers will make up the October issue. There will also be photos and news of the new officers, prize winners, and Honorary Members.

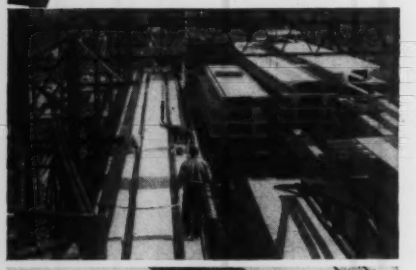
The AEC's gaseous diffusion plant near Portsmouth, Ohio, cost $400 million less than expected? When this plant began full production of atomic fuel (U-235) in March, six months ahead of schedule, construction costs were found to total $800 million instead of the originally estimated 1.2 billion—a saving of 34 percent. Much of the credit is being given to the team headed by Peter Kiewit Sons' Company, holder of the huge construction contract, and to Kenneth A. Dunbar, Portsmouth area manager for the AEC. At the peak of construction, 20,500 men were employed on the plant. Goodyear Atomic Corporation is the operating contractor.

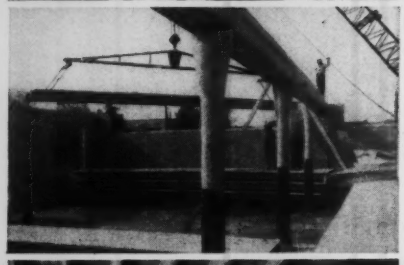
A water pollution control program is in the cards? Recently enacted federal legislation provides for a ten-year $500,000,000 program of water pollution control. It directs that 50 percent be spent on cities of less than 125,000 population.

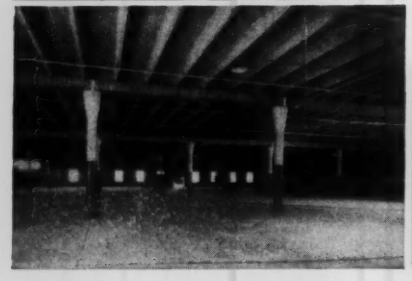
The Indiana Toll Road will be completed in September? Ceremonies formally opening the new 156-mile superhighway across Indiana will be held at South Bend on September 17. Motorists so disposed will then be able to drive from New York to Chicago without stopping for a single red light.



ECONOMY WITH A BIG E







Precast and Prestressed 'Incor' Concrete Frame and Roof —Strong, Durable, Fire-safe . . . for $1.25 per Square Foot

● The owner of this warehouse posed two requirements: It had to be 100% fire-safe, and within the limits of a modest building budget. All-concrete construction was the logical answer to the first requirement, and a combination of precast and prestressed structural members met the second "must."

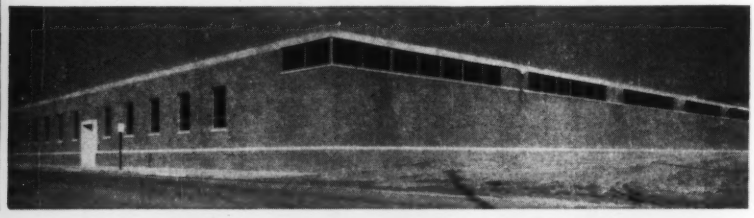
The most economical design called for roof members with 40 ft. span and the solution turned on the use of precast, prestressed double-T roof-deck members. Columns, 13 ft. clear height, and beams of 21-ft. span were precast.

Maximum economies were realized by fabricating members to closest tolerances in the casting yard to assure economical erection, using 'Incor' 24-Hour Cement for assembly-line production speed and lowest unit production cost.

End result is a fine building with the fire-safety and durability of all-concrete construction, at $1.25 per sq. ft. for frame and roof. Total cost of completed 31,000 sq. ft. warehouse, heating plant included, $4. per sq. ft.

When economical cost is the object, and it nearly always is, use 'Incor' for maximum production economies and fullest realization of the advantages inherent in prestressing.

L. H. JENKINS, INC., Shipping & Storage Warehouse
Architect: MARCELLUS WRIGHT & SON
Contractor: WISE CONTRACTING CO., INC.
Precast & Prestressed Units: CONCRETE STRUCTURES, INC.
—all of Richmond, Va.



LONE STAR CEMENTS COVER
THE ENTIRE CONSTRUCTION FIELD

LONE STAR CEMENT CORPORATION

Offices: ABILENE, TEX. • ALBANY, N. Y. • BETHLEHEM, PA.
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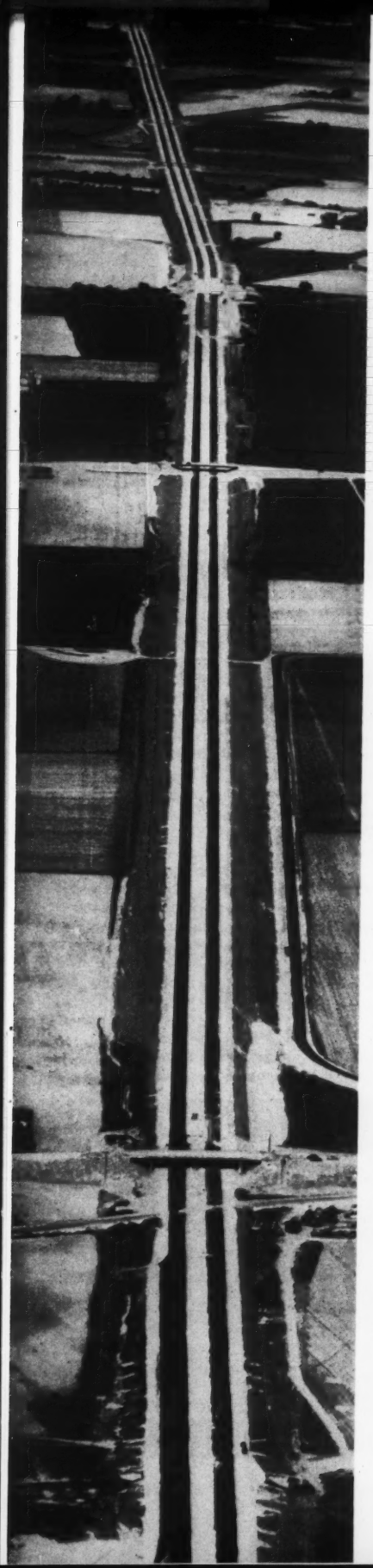
LONE STAR CEMENT, WITH ITS SUBSIDIARIES, IS ONE OF THE WORLD'S LARGEST CEMENT PRODUCERS: 18 MODERN MILLS, 38,000,000 BARRELS ANNUAL CAPACITY



Highways of the future

Our nation is now road conscious and something is about to be done about it. The new federal highway legislation—the largest public works appropriation in history—constitutes a revolutionary development in the thirty-year battle to bring our highways to a standard of modern design and construction which will be in keeping with our present highly motorized economy. The Congress and our federal administration are to be complimented highly on the courage and forward looking viewpoint evident in the drafting and enactment of this new legislation. Our highway problems could never begin to be solved with a less bold approach to the financing and construction of these new facilities.

With all the current talk about the shortage of engineers, there is full reason to discuss the capacity and adequacy of our highway engineers, their state and private organizations, and our highway contractors and material suppliers to produce promptly the services demanded by the new program. No doubt the facilities and capacities of our state highway departments, supplemented by their highway engineering firms, will be fully taxed in getting this program organized and under way, but there appears no sound reason to question their ability to function adequately.

The flexibility and resourcefulness of our civil engineering and construction agencies were fully tested in the early part of World War II and the days preliminary to it. Throughout the war, at home and over the seas, our engineering and construction organizations performed legendary feats. These abilities and resources are still ours.

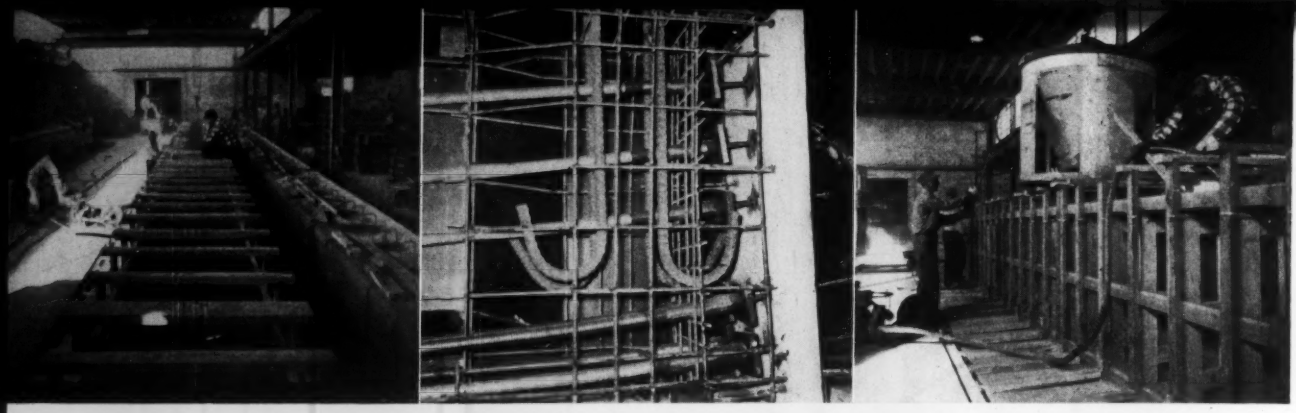
New engineering methods and design techniques are now available to us which have never been fully utilized heretofore. Aerial photography, although not new, is steadily advancing in accuracy and scope. The newest electronic and mechanical computing devices are being adapted to engineering work. Stress calculations for complicated structures, geometric determinations for large and intricate highway interchanges, and the computation of large earthwork volumes, are typical of the formerly tedious calculations for which computing machines are now used.

Changes in the assignment and use of professional civil engineers are already in progress in numerous highway organizations. Heretofore we have seen graduate civil engineers of experience used in such activities as real estate acquisition, personnel work, and office administration simply because they were filling these positions most capably—although not to their own greatest professional advantage. We can go a long way toward meeting any expanded demand for civil engineering services by using professional civil engineers in professional work. As was proved in World War II, it is surprising how quickly engineering aides and assistants of a non-professional type can be enlisted and trained, greatly relieving the burdens of professional engineers.

The hopes and expectations of many years are being realized by our state highway authorities in the legislation for our new federal highway program. The highway engineers and builders are ready to do their parts in bringing the new highway system into existence on schedule.

Enoch Needles

President, ASCE



In casting plant, left, one prestressed girder has been cast and stripped and adjoining one is ready for casting. In detail, center, anchorages for prestressing steel and lifting hooks are seen in end of girder before casting. Swiss BBR button-head anchorage system, as developed in this country by Formigli Corp., was used. Above, concrete is being placed in a girder.

Factory-made prestressed-concrete

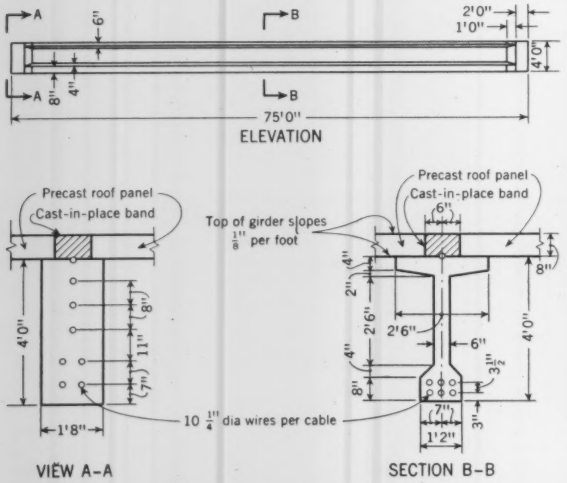
With the acute demand for cement throughout the country, most cement manufacturers are in the midst of expansion programs. The Lone Star Cement Corporation is no exception, and in its 1955 expansion program is modernizing and expanding its plant at Nazareth, Pa. This program includes a new building for milling the raw products used in cement manufacture and grinding the clinker into finished cement.

The most interesting feature of the new 75 × 272-ft building is its structural system, in particular the precast and prestressed roof deck which covers the full 20,000 sq ft of floor area with no interior columns. The fabrication, shipment, and erection of the prestressed roof girders and the precast roof panels strikingly illustrate the new possibilities opening up for concrete construction.

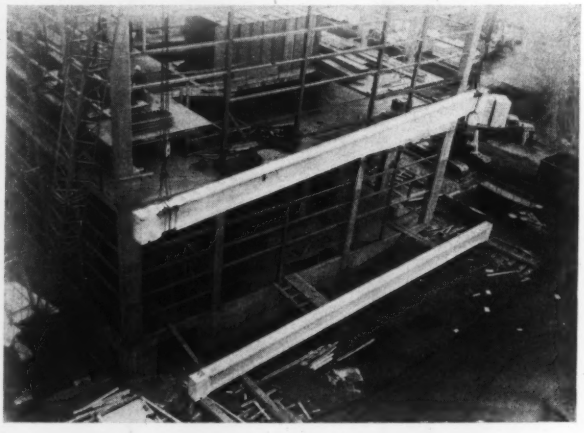
The structure is 70 ft high and has numerous working levels at various elevations. It is high and narrow in order to accommodate machinery of large size and provide for the flow of materials. Ventilation is complicated by the heat released from the 10,000-hp output of machinery within the building. To meet this problem, 3,500 sq ft of louver area was supplied along with liberal openings at each of the working levels. The free air circulation thus provided makes use of the 70-ft stack effect by exhausting through the 68 Swartwout Air-Mover roof ventilators. This arrangement has been designed to move air at the rate of 146,000 cu ft per min.

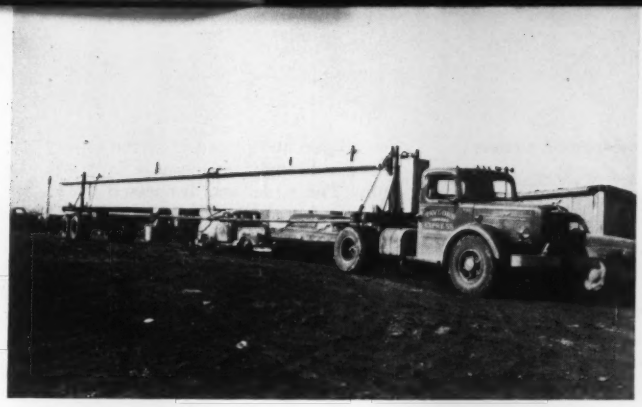
Stiff monolithic concrete framing has been found desirable to resist vibrations set up by heavy equipment in similar installations. Accordingly, this building is designed as a monolithic cast-in-

FIG. 1. Prestressed girders spanning full 75-ft width of building provide roof with no interior columns.



Two cranes, one on each side of building, with booms up, lift girder 70 ft to position on top of columns.





Special trailer transports 75-ft girder 90 miles to site. Nineteen of these factory-made prestressed concrete units, each weighing 20 tons, were transported in manner shown.

DAVID P. BILLINGTON, J.M. ASCE, Project Engineer
and **MARVIN E. WARNER,** Project Manager
Roberts and Schaefer Company, New York, N. Y

girders trucked 90 miles to site

place concrete structure, except for the long-span roof. All foundations were carried to bedrock.

Choosing the roof framing

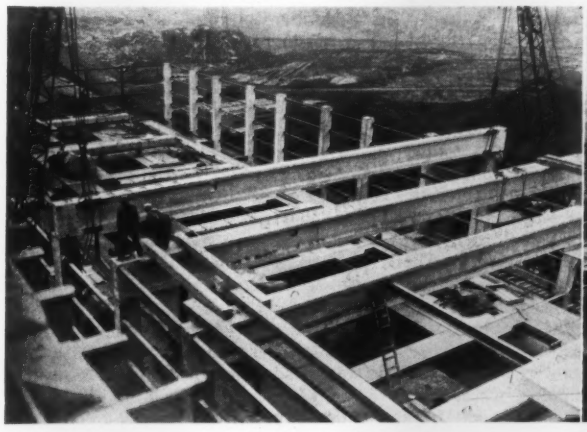
Roberts and Schaefer Company was asked to make a comparative cost analysis of various roof systems. Cast-in-place, thin barrel-shell concrete; precast, prestressed concrete girders; structural steel trusses; and structural-steel rigid frames, all were investigated. The least costly systems were the structural-steel truss with metal roof deck, and the precast prestressed concrete girders with precast, channel roof slabs. A cost comparison of these two showed the steel solution to be slightly less expensive. However, the inherent advantages of precast and prestressed concrete, such as freedom from maintenance, fire resistance, pleasing appearance, and availability of materials, justified the small increase in initial cost.

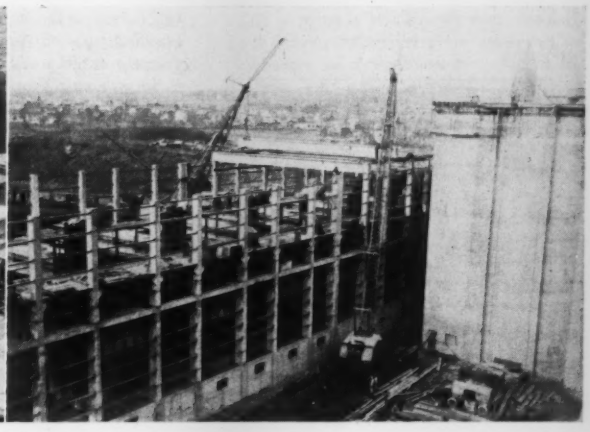
Designing the roof

The roof consists of precast, prestressed concrete girders 75 ft long, spaced 18 ft and 14 ft alternately on centers, and resting on cast-in-place concrete columns (Fig. 1). Precast roof panel units, 5 ft wide and 13 and 17 ft long, span the distances between girders. These panels were designed as simple beams for dead load and as continuous beams for live load. They are tied to each girder through a cast-in-place band by dowels and keys in the concrete, so as to provide composite action between girders and slabs under live load.

The prestressed girders were designed for two critical loading conditions: (1) the initial prestressing force, plus

Cranes move each girder along from one pair of columns to the next until final position is reached. At left below, note girt bracing between ends of adjacent girders Composite-acting roof will be completed by placing and tying in of precast slabs.





the dead load of the girder, and (2) the final prestressing force, after all losses, plus full dead and live loads.

The initial prestressing force of 500,000 lb for the interior girders was obtained by 7 cables, each with 10 wires of $^1/_4$-in. diameter having an ultimate strength of 215,000 psi. This amounts to an initial stress of 143,000 psi in the steel. A 16-percent loss of steel stress was assumed, so that the final working stress would be 120,000 psi.

The maximum temporary concrete stresses under Condition 1 were 2,440 psi in compression and 85 psi in tension, at the bottom and top flanges respectively, at the center of the span. A cylinder strength of 4,500 psi was specified for this condition. Actually, an average cylinder strength of 5,000 psi was obtained before the full prestressing force was applied.

The criterion for the girder design in Condition 2 was that there should be no tension in the bottom flange at the center of the span. The girder alone was designed to resist the concrete-roof dead load and the temporary live loads. Full live loads, roofing loads, and loads from the 5-ton and 10-ton monorails, were designed to be resisted by the composite section of girder and roof deck. For this reason the final concrete compression stresses in the top flange are low—a maximum of 1,300 psi. A 5,000-psi cylinder strength at 28 days was specified. Actually, the average 28-day strength obtained was 6,300 psi.

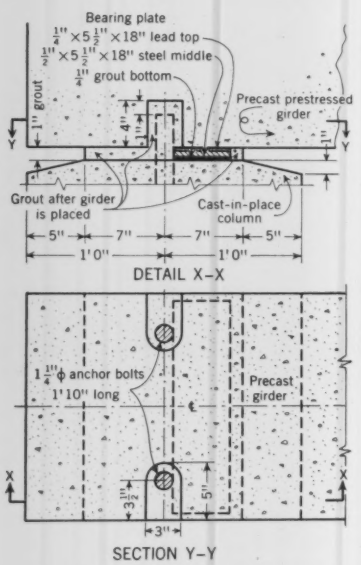


FIG. 2. At each end, girder rests on lead and steel bearing plates on column. Embedded dowels hold girder in position.

Fabricating the prestressed girders

Prestressed girders were made at the plant of the Formigli Corporation in Berlin, N. J. Two wood soffits were built, but only one set of steel side forms was used for the 19 girders. One girder was cast about every three days. Three or four days after casting, a girder was partially prestressed with about 55 percent of the total design force, so that it could be moved and the forms prepared for another. After four to six days the remaining prestressing force was applied.

Construction at the site

The nineteen 75-ft prestressed girders were erected in January 1956, after being trucked about 90 miles from their point of fabrication. Previously it has been the general custom to ship only relatively small precast units and to cast large units on the job site. Experience on this project showed that large factory-made members can be transported for relatively long distances conveniently and economically. In choosing this method of construction, the Lone Star Cement Corporation took cognizance of the following advantages:

1. Quality-controlled concrete would be cast in carefully constructed steel forms, producing a structurally sound unit and a smooth, attractive finish.
2. The high-strength steel would be placed, tensioned, and grouted by experienced men, using well tested equipment.
3. The girders would be shipped on the special trailer trucks used frequently by this manufacturer for units of similar type. They were trucked directly from the factory to the job site.

Erection of these 20-ton girders appeared to be a difficult problem because of the great height to which they had to be raised—70 ft from the ground to the top of the columns. Also adjacent buildings restricted the movement of the construction equipment. Actually, erection proved to be simple and extremely rapid. All girders were erected in four working days, and the last eight were placed in one working day.

One 60-ton and one 50-ton crane were used, stationed opposite each other, one on each side of the 272-ft-long building. Half the girders were delivered to, and erected from one end of the building, and the other half were delivered to, and erected from the other end. The idea was to lift all girders at one of two points and move them along without walking, while keeping the booms as nearly vertical as possible.

Initially the cranes were stationed at the first pair of columns, where they lifted the first girder up straight from the ground and placed it on the tops of the second pair of columns from the end. The girder was connected to the columns by a connection developed to allow easy construction and to provide, after grouting, a non-sliding hinge at supporting points under all conditions of load. This connection is shown in Fig. 2. Remaining in the same position, the cranes lifted the second girder and placed it on the tops of the first, or end pair of columns. The two girders were immediately connected and braced by the steel angle girts shown in a photograph.

The two cranes then picked up the third girder and placed it on top of the girder already in place on the first or end pair of columns. Next the cranes were moved to the second pair of columns, where they picked up this third girder and moved it over onto the girder already in place on the second pair of columns. Again the cranes were moved along to the next pair of columns, this time to the third pair, and in this position they again picked up the third girder and placed it in its final position on top of the third pair of columns. The cranes then moved back to the first pair of columns to pick up the fourth girder, which they moved along from one pair of columns to the next in the same manner, proceeding toward the center of the building.

It was intended that this method would be repeated from the opposite end, but because of the skill gained in handling the girders, the last eight were erected in one day by allowing the cranes to walk with the girders suspended from them. In spite of the windy weather, the girders proved to be so stable that there was no excessive swaying while the cranes were in motion.

Completion of the roof involved placing of the precast roof panels and casting of the slab band between panels and girders.

This building was designed and detailed by Roberts and Schaefer Company under the direction of D. P. Denitto, Manager of the A-E Department. Marvin E. Warner was in direct charge of the entire job, and David P. Billington was responsible for the precast and prestressed design.

Chief Engineer for the Lone Star Cement Corporation was R. A. Rasmussen; Olaf Kayser was in charge of construction. General construction was performed by the E. C. Machin Company of Allentown, Pa. The prestressed girders and precast roof panels were manufactured by the Formigli Corporation of Berlin, N. J., and the subcontractor for the erection of the girders and roof panels was J. D. Fegely of Allentown, Pa.

Placing concrete in a deep mine

Grout dropped 3,000 ft into prepacked forms for pump station in South Africa

BRUCE A. LAMBERTON, A.M. ASCE

Head of Research and Development, Intrusion-Prepakt, Inc., Cleveland, Ohio

Placing of structural concrete in mine workings involves problems that are not only uncommon in the mining industry, but also unfamiliar to most civil engineers. However, a discussion of this type of concrete installation may have application in such civil engineering construction as tunnel lining, installation of plugs in dam sluiceways and galleries, and buried military and industrial installations.

The amount of underground mine concrete work in this country has always been small because of the general lack of serious water problems and the expense of concrete as compared to timber and steel. In the Union of South Africa, however, where the writer spent six months on deep concreting work, men dig deeper, more persistently, and probably more profitably than anywhere else on earth. While the Kimberly diamond workings are probably the best known mining operation in Africa, gold mining operations on the Rand and, more recently, in the Orange Free State, are on a much more spectacular scale.

Some of the older gold mines in the vicinity of Johannesburg are down beyond the 10,000-ft level and employ as many as 35,000 native miners on a single property. Workings are serviced by man hoists that may drop 100 men in a cage a mile straight down below the earth's surface at speeds up to 3,000 ft per min (33 miles per hour). Underground substations, pump chambers, and air conditioning plants are of sufficient capacity to serve small cities. The complexity and extent of the underground operations and the heavy subsurface water flows encountered, particularly in the new Free State gold fields, require heavy concrete installations.

One project of particular interest was an underground pump station undertaken for the Stilfontein Gold Mining Company near Klerksdorp, Transvaal, approximately 120 miles west of Johannesburg. Here about 1,300 cu yd of Prepakt concrete were placed in a pump station located 3,000 ft below the surface. See Fig. 1.

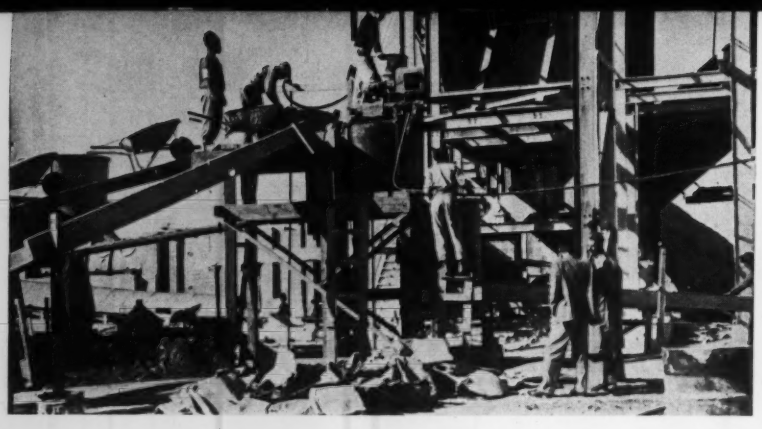
By South African standards, this mine was not a particularly difficult one as regards water control. Shafts and workings are relatively dry and humidity is kept at a comfortable level with the aid of moderate grouting and good ventilation. Pumping requirements were about a million gallons per day. In sharp contrast to the brackish water of the Free State mines, which is unfit even for irrigation, water from Stilfontein is potable and is used to supply the town of Stilfontein. To simplify pump maintenance problems, water is passed through a series of concrete settling basins and sludge separators before delivery to the pumping station. These installations are all located about 3,000 ft below the ground surface.

Shaft space a bottleneck

Conventionally crushed coarse aggregate, sand, and cement for mine concreting are lowered down the shaft to the operating level, hauled in wheelbarrows or mine cars to the mixer, and poured in the conventional manner. One of the principal disadvantages of this arrangement is the fact that considerable time is required for hoisting materials. On small pours this may be insignificant, but on projects requiring several hundred cubic yards of concrete the loss in shaft operating time is very important.

A further difficulty arises from the fact that mines are staffed to perform routine and maintenance types of construction, but not heavy new construction. From a personnel standpoint, it would be convenient if large new construction projects underground could be awarded to independent contractors in much the same manner as are major surface installations. The main difficulty with this arrangement in the past has been that all the contractor's material had to be handled down the shaft, making for an awkward division of responsibility. The importance of this problem will be obvious in view of the fact that movement of materials on a lift often has to be scheduled several days in advance.

The use of a Prepakt installation in place of conventional concrete appeared to overcome these difficulties for the most part. Forms could be filled with coarse aggregate consisting entirely of waste mine rock taken directly from the workings. The rest of the necessary concrete materials—sand, cement, water and admixtures—could be combined in a surface mixing plant to form a slurry and pumped down the shaft and into the forms to solidify the preplaced coarse aggregate. Once form materials and equipment were in place at the job level, the contractor would need shaft time only for transporting personnel at normal shift-change periods.



Mortar was mixed at surface (above) in compact plant. Intrusion mortar was blended in mixing tub and dropped to agitator, whence slurry moved by gravity through $1^1/_2$-in. flanged pipe to agitator at working level. It was then delivered to forms by a small mortar pump (right).

Processing aggregate

In preparing the aggregate for the Stilfontein mine, the waste mine rock was passed through a trommel-type wash screen immediately before placement in the forms to remove minus $^3/_4$-in. material and to clean rock particles of surface dust to insure an ideal bond with the Prepakt mortar. Coarse aggregate ranged in size up to pieces as large as a man could comfortably lift. Mortar was mixed on the surface and delivered down the shaft through a $1^1/_2$-in. pipe, which was used during shaft sinking for pressure grouting and was left in place for any further grouting that might be required during development work.

At the start of this project, excavation in the pump chamber was completed only as far as the adit from the settling basins. As concreting operations on the shaft end of the chamber progressed, excavation continued as necessary to supply coarse aggregate and to prepare the chamber for lining. The length of the chamber was such that blasting at the far end did not disturb concreting operations. Development operations in the pump chamber were actually completed at about the time the wall lining reached the halfway mark. A continuous supply of coarse aggregate was thus available right at the job site and, if necessary, could have been supplemented from mining operations in nearby workings.

As might be expected, several difficulties were encountered in putting theory into practice. Perhaps the least of these was the gradation of coarse aggregate. Stone actually ranged from about 1 in. to over 12 in., but with a deficiency of smaller sizes so that the void content ran about 45 percent. This is a rather high percentage for aggregate with such broad gradation limits. The only effect was to increase cement requirements beyond those anticipated, since the void content originally estimated was about 38 percent. The strength of the concrete in place, as measured by a Schmidt rebound hammer, did not seem to be affected. Durability, under the ideal and constant conditions of temperature and humidity prevailing at the site, was not a significant factor.

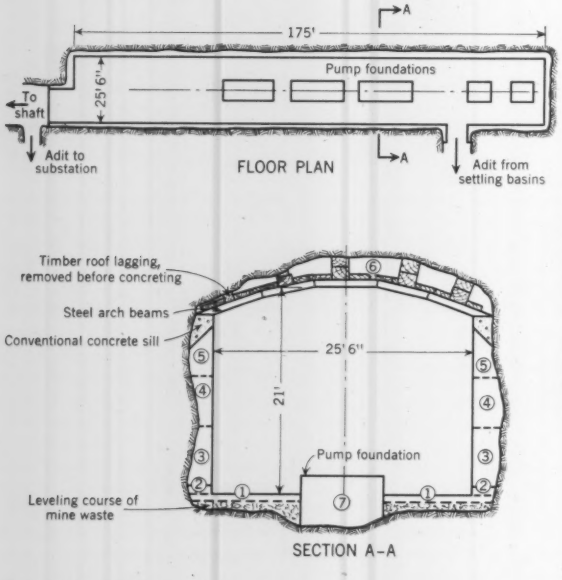


FIG. 1. Pump chamber in mine of Stilfontein Gold Mining Co. in Transvaal, Union of South Africa, was lined with Prepakt concrete. Circled numbers in Section A-A indicate sequence of concrete placement.

Mortar designed to prevent plugging

A second and far more important problem was that of mortar delivery. A variety of mixes were tried using straight portland cement, pozzolanic cement, and a mixture of portland cement and fly ash, in combination with Intrusion Aid and several blends of sand. It was found that, unless caution was exercised in the design and preparation of the mix, line plugs would occasionally develop between the 2,500- and 3,000-ft levels. Removal of plugged pipe sections naturally caused interruption of shaft operations, much to the discomfort of both the contractor and the mine operator. Eventually, however, a satisfactory mix was

Protruding aggregate provides excellent bond to succeeding lift. Lift joint of curb section appears in foreground. Absence of small coarse aggregate in ungrouted section (far left) increased cement needed but did not noticeably affect strength.

Wall lining was constructed in three lifts between curb section and conventional concrete sill which supported steel roof beams. Trommel screen in foreground cleaned coarse aggregate of surface dust and removed $^3/_4$-in. particles. ⟶

developed using approximately 2 cu ft of blended sand to one bag of pozzolanic cement, 1 percent of Intrusion Aid by weight of the cementing materials, and a water-cement ratio of about 0.51.

The principal functions of Intrusion Aid in this particular instance were to increase fluidity, reduce bleeding, retard set, and cause a slight expansion of the mortar in the aggregate mass during set to counteract setting shrinkage. It produces a cohesive slippery mortar, much less susceptible to line blockage than normal sand-cement grout, but without the considerable reduction in strength resulting from the use of Bentonite, a common mine grouting admixture. Under the severe conditions existing here, the use of Intrusion Aid was felt to be absolutely essential.

Mix control was maintained by the use of standard grout flow cones, one at the mixing plant on the surface and a second at the lower end of the delivery pipe in the pump chamber below. Flow cones are used to determine the time of efflux of a measured quantity of mortar through a machined orifice. Time of efflux in this particular case was held to a variation of about plus or minus one second.

Construction of the floor varied somewhat from the usual Prepakt procedure. The floor of the original rock chamber was filled to a level about 6 in. below final grade with mine waste including fines removed during rock washing procedures. A 6-in. layer of clean aggregate was placed on top of this leveling course of waste rock and was solidified by injecting Intrusion mortar through inserts which were worked down into the clean aggregate layer as far as the leveling course. The mortar surface was then screeded to produce a surface satisfactory for normal use.

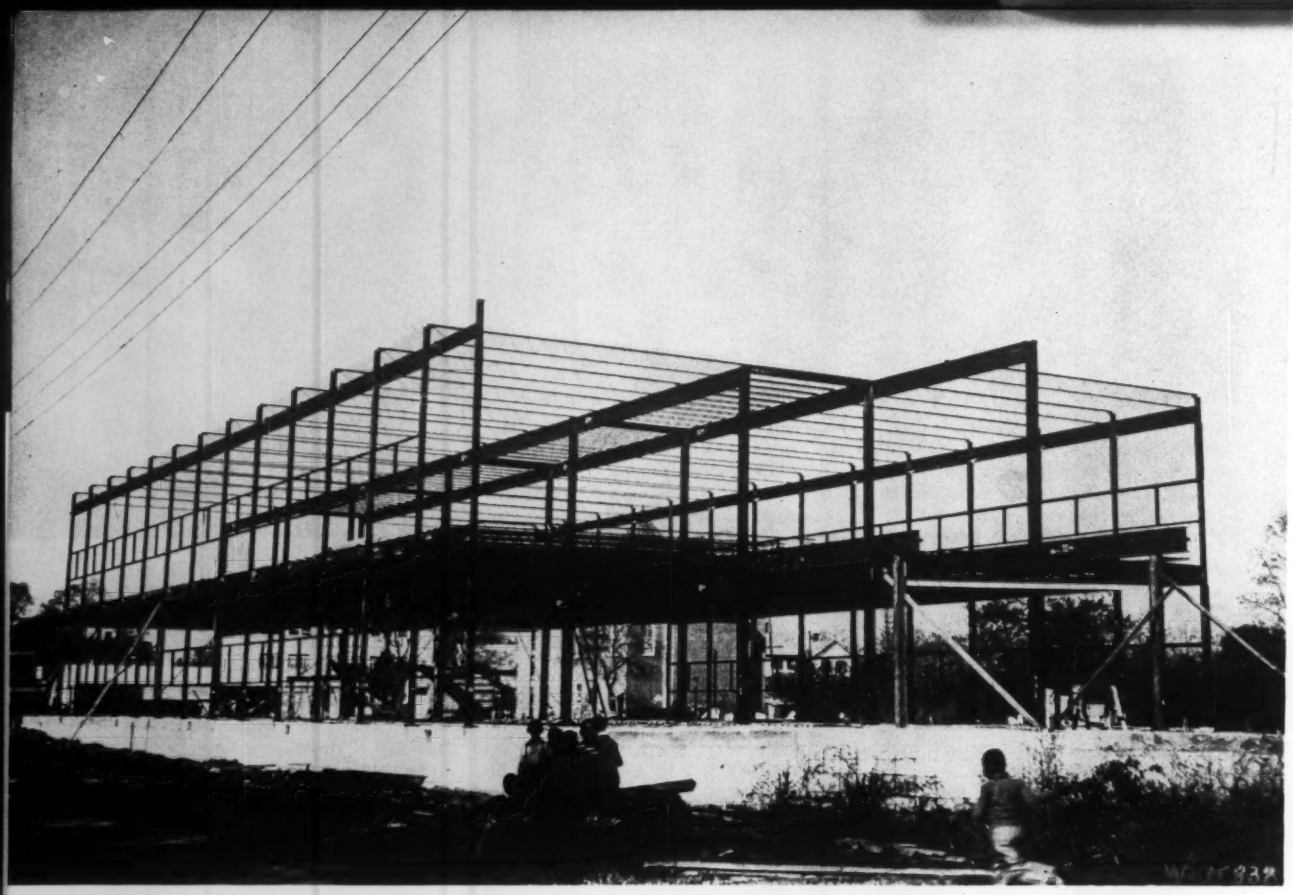
Sequence of pours

The length of each pour was generally about 30 ft. Floor and curb sections were constructed in advance of wall pours, which in turn were constructed in advance of the ceiling. By advancing construction stages in this manner, a smooth working platform was always available for erection of scaffolding and wall forms and for rock handling operations. Wall lining was essentially completed up to the adit from settling basins at the time construction of the roof lining was started. Steel arch beams on conventional concrete sills were placed during development work in the pump chamber. Forms for ceiling lining were supported by scaffolding from the floor and were kept to line and grade by clamping to the steel arch beams. Tubular steel scaffolding was adjusted to proper elevation and lowered for stripping by means of screw-type jacks. Timber lagging between the steel arch beams and the rock roof was removed immediately prior to ceiling concreting. Pump foundations were installed last. The sequence of concreting operations is shown in Fig. 1.

Ceiling construction was difficult only because placing of the coarse aggregate presented something of a problem. Steel arch beams were on 5-ft centers. Three of these roof sections, a total of 15 lin ft of lining, constituted a single pour. Coarse aggregate, after being passed through the rock washer, was carried to a builder's hoist which elevated it to the level of the arch beams. From this point it was manhandled by native labor back into the area between the forms and the rock roof. Overbreak, above the top of the steel arch beams, was sufficient to permit men to crawl through to place stone. Roof sections were placed in alternate pours of 15 ft each to economize on form use and to permit maximum utilization of men and equipment.

For the successful completion of this work, involving the placing of about 1,300 cu yd of concrete, too much credit cannot be given to the management of the Stilfontein Gold Mine, without whose wholehearted cooperation development of this technique would have been impossible. Construction problems of considerable difficulty were encountered and overcome and it is hoped that the methods developed may prove useful in other types of underground work. By these methods, wasteful double handling of coarse aggregate—from the working face to the surface and back again—is eliminated. Mining crews have free access to the working face without interruption by long lines of mine cars carrying concreting material. The Prepakt method, by its very nature, assures a tight bond between the lining and the original rock face, eliminates the necessity for crown grouting, and provides a dense, impermeable, attractive lining at a saving over conventional methods.

This process, first used at the Loraine Gold Mine, Orange Free State, at levels of 3,000 and 5,300 ft below ground, was jointly conceived and carried out by Cameron McLauchlin, General Manager for Loraine; Michael Wright, the Free State Branch Manager of Roberts Construction Company; and John C. King, A.M. ASCE, Chief Engineer of the Prepakt Concrete Company. Work at Stilfontein was carried out by the Transvaal Branch of Roberts Construction Company with the invaluable assistance and cooperation of Nigel Morgan, Mine Manager, and Kenneth McMillan, Resident Engineer.



WELDED FRAMING FOR

VAN RENSSELAER P. SAXE
M. ASCE

Engineer, Baltimore, Md.

Photo above:
Grade school building at Chestertown, Md., is typical of current school design, with large classrooms flanking central corridor. Bar joists frame roof and first floor. Exterior columns are light and are spaced to fit fenestration. Corridor columns can be heavier and spaced for economical span lengths. Structure was designed by engineering firm of Van Rensselaer P. Saxe, with Buckler, Fenhager, Meyer & Ayers, architects.

Because of the seemingly endless demand for additional school facilities and the difficulties in raising funds for such purposes, school authorities are trying to hold down construction costs. Obviously it is the responsibility of the engineer to keep costs down so that as many classrooms as possible can be provided with the limited funds available.

In the Baltimore area, most schools constructed before World War II were three- and four-story buildings, of reinforced concrete, though some were of steel with concrete floor systems. In the years since World War II, there has been a growing tendency to erect one- and two-story buildings, having in addition large gymnasiums, cafeterias, swimming pools and auditoriums. These are used both by the pupils and by the general public in surrounding areas.

This change in the general concept of school buildings has opened the way for different types of construction. Many of these types offer considerably greater speed of erection as well as definite economies in comparison with reinforced concrete, which loses much of its former cost advantage when lower buildings are involved. This is due to the limited opportunity for the reuse of formwork and the current high wages of carpenters and other labor.

Many of the new one-story schools have the first floor laid directly on the ground. Where a crawl space is required, we find it most economical to use one of the various types of precast concrete joist slabs. These provide economy because there is little or no carpentry formwork to be constructed on the job, and large areas of floor can be placed in a single day.

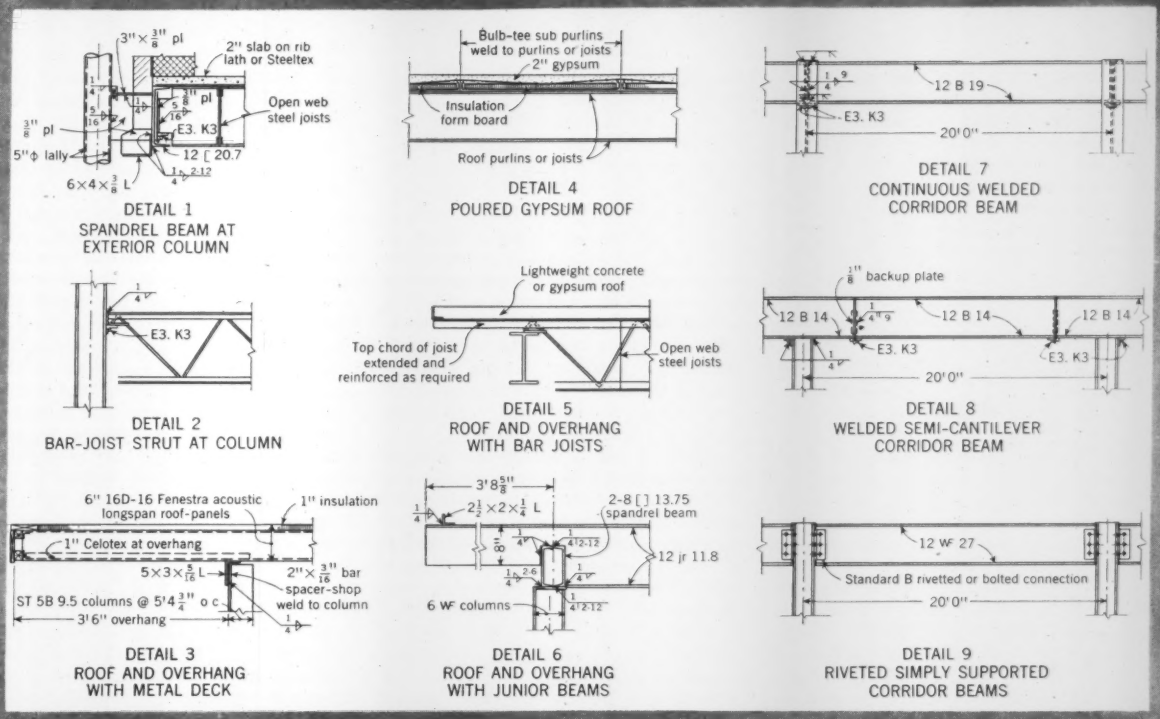


FIG. 1. Typical standard details for school framing show economical welded practice. Note weight saving through development of continuity in corridor beams.

economical school buildings

Steel frames economical

For the floors of similar two-story buildings and the roofs of both types, we find that a steel-frame structure with some type of steel joist or metal-deck floor system between supporting structural members most nearly fulfills the low-cost requirement. At the same time, it gives architects the use of supporting members of small size which is desirable as it makes possible the type of fenestration so widely used in new buildings.

The typical school building has classrooms on each side of a central corridor. The rooms vary in width from 22 to 26 ft, and the corridor widths run from 8 to 12 ft. From a structural standpoint, the engineer is pretty well restricted in getting the most economical structure for these spans. Supporting interior columns are placed for the most economical spans, avoiding classroom entrances. Exterior columns are spaced along walls to give the architect the window and overhanging hood arrangement he wants, even to having supporting posts between each sash so that the support will not show. We often use round Lally-type, fireproofed steel columns on the outside of walls to improve the architectural appearance. (Fig. 1, Detail 1.)

Floor framing

In general, we find it most economical to use bar joists, Jones & Laughlin junior beams or deep-trough metal decks similar to Fenestra or Robertson as the floor supporting system. These are, in turn, supported by the structural steel columns and girders running the length of the building in exterior walls and corridor partitions.

Where bar joists are employed to support the floor, they can be used satisfactorily as a strut between columns. With the main structural members developed, it then becomes a simple matter to space and tack-weld bar joists of proper size to the top flanges of the longitudinal girders, attaching them to columns where they act as struts (Detail 2).

In cases where junior beams are used, the same procedure is followed. Often, when using junior beams, it is possible to develop continuity which will cut down on the tonnage of such beams required.

Sometimes, if the longitudinal spacing between wall columns and columns in the corridor walls is not too great, bar joists or junior beams can be used as girders in place of structural steel beams. This is especially true in roofs where loads are not heavy.

Whenever this is done, the longitudinal members usually must have a greater depth than would be required with steel beams. This greater depth often requires a greater story height and, because of additional materials such as partitions and brickwork, may not prove to be a saving. Often too, the use of bar joists as girders may require special fabrication of joists to support members framing into them.

The surface placed over floor joists is either a 2-in. or a 2 $^1/_2$-in. concrete slab with a smooth finish prepared for receiving asphalt tile or linoleum. In the case of corridors and toilet rooms, where terrazzo or some other hard surface is to be used, the base slab is left with a raked finish to receive the hard surfacing. In some cases, these slabs are integrally finished with one of the hard surface coats, such as Hydroment. To comply with fireproofing regulations, ceilings under these floors are subject to considerable variation in finish. Probably the most common is plaster board $^1/_2$ in. thick attached to light furring channels. Various types of accoustical tile can be applied to this plaster board. Another widely used ceiling finish, because of its good sound absorption and high fire resistance, is Perlite plaster. It is applied to metal lath attached to the underside of joists. In schools where cost is the major consideration, wood furring strips are attached to the bottom of joists. A fire-resistant type of accoustical tile is then nailed or screwed to these strips.

Roofing

For the roof of this type of steel-frame building, there is a greater latitude in choice of material than for floors. A designer, knowing the materials most easily procured in a specific area, can use these as the basis for his design. Though different methods can be used, there is only a slight variation in built-in-place costs. Construction speed, however, may make some roofing materials more desirable than others.

Depending on architectural requirements, there are many satisfactory types of roof deck. The roof deck can be constructed of the same material as the floors, but in steel-frame school buildings, where there is no penalty in varying the roof and floor structure, it pays to use lighter and more easily handled materials in the roof. In reinforced concrete construction, however, it is desirable to make the roof similar to the floors to get optimum reuse of forms. For general economy, our roof layouts are entirely different from the floors, although the column spacing remains the same as that in the floors below.

For hung ceilings under roofs, we find the metal deck or precast gypsum planks or poured-in-place gypsum, properly insulated, to be a fast and economical type of construction (Details 3 and 4). These materials produce a ceiling of very satisfactory appearance. Most architects however prefer a better finish and one with accoustical properties. To achieve this, architects frequently use metal decks with accoustical insulation as an integral part of them, or decks with poured-in-place gypsum in which insulating fiberboard forms the support.

Many of today's schools have rather wide, sun-shielding roof cornices. We find it economical to design bar joists with special ends to act as cantilevers beyond the wall-support beam (Detail 5). Often, where these cantilevered cornices have downward sloping faces, the junior beam, with the bottom flange burned off, produces a neat finished job whether exposed or covered with stucco or other finish (Detail 6). When the structural roof members extend beyond the body of the building, the projecting sections should be insulated from the ceiling space between floors. This prevents condensation caused by cold temperatures conducted into the warm ceiling areas by the exterior steel members.

Because of the large size of many school buildings and the angles of the various units with reference to the main building block, it is as essential to provide expansion joints as in large reinforced concrete structures. This is especially important where main walls and corridors have a length of over 300 ft or where there are breaks in the wall or corridor direction. Providing a pair of slightly separated columns on a single foundation is the most satisfactory way to provide for expansion and contraction. This permits the necessary break in the floor system or walls. Floor joints are covered with expansion plates, and wall joints are filled with calking compound. The joints do not have to go straight across the building or area. With a little study, they can be placed where neither the extra column nor the joint in the floor is noticeable.

One other feature of school buildings which has been a source of annoyance to architects and engineers alike is the tendency of parapet walls to push and crack at the corners of buildings. It is most pronounced where blank end walls are made part of the main structure and act as bearing walls without structural support. To eliminate this condition, all wall columns above the general roof level should be extended for a distance of at least one foot. Wall columns are placed in blank end walls, even though they support nothing but the walls themselves. These columns should be connected to the floor and roof-beam systems so they are an integral part of the structural system. These precautionary measures do add to the cost but are definitely worth while.

Much has been written about the possibility of making schools and other buildings blast resistant. However, because of the many variations in the direction of forces entering into such a design, it seems utterly impractical to construct such a building at reasonable cost. It would of course be practicable to design a welded building so as to produce a fairly economical structure capable of withstanding a heavy blast load from any direction. Such a building would have the round-rod type of bar joists throughout—with horizontal lateral bracing between the top and bottom chords. Even though it might not be possible to protect all the other elements of the building, at least the structural frame would remain standing and the damaged elements could be repaired.

As structural supports for floor and roof systems, we find welded steel structural frames most economical because of their greater design economy and increased shop and erection speed. Since the classroom part of school buildings is usually of considerable length, an important saving in structural steel can be realized if the longitudinal run of beams is either designed for continuity and is welded at the columns (Detail 7), or is designed as a semi-cantilever (Detail 8). Either of these methods yields considerably more economy than the simple-beam design usually developed when rivets or bolts are used (Detail 9).

Where steel is exposed, the architect has no objection to the appearance of welded structural work. In fact it adds greatly to the appearance of such rooms as cafeterias, gymnasiums, assembly rooms, and shops. It produces attractive beamed classroom ceilings under roofs where accoustical metal decks or insulated gypsum slabs are used. The neat appearance of a plain structural steel member, without exposed rivets or bolts, is in keeping with modern design concepts.

Space will not permit a detailed analysis of costs. In brief, it has been our experience that welded structural steel buildings show an average structural cost saving of about 10 percent over similar buildings of reinforced concrete. In addition, a welded steel design always reduces construction time.

LET'S TAKE THE WASTE OUT OF STRUCTURAL DESIGN

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Like all other professions, engineering can't always be reduced to a formula. The human factor looms large—sometimes it works for the profession, sometimes against it. And nowhere is the human element more in evidence than it is in structural design.

This year a fortune will be spent in the study of building materials, and countless hours devoted to the preparation of technical papers to show the latest techniques for analyzing structural members. But in spite of all this, many engineers will still needlessly waste materials by overdesigning their structures. Familiar to most of us are those who: (1) choose a steel beam one size larger than required, (2) use a concrete slab one or two inches thicker than necessary, (3) pick a design load higher than that recommended by the controlling code.

Higher costs and hidden costs

In all these cases the owner not only pays the higher costs of the structural materials, he also pays hidden costs. Thicker floor members require a corresponding increase in wall surfaces; heavier dead loads result in larger columns and foundations; and graceful proportions give way to bulkiness.

Overdesign is poor design, just as underdesign is poor design. But while underdesign results in structural failure, overdesign usually goes unnoticed. There are various causes for overdesign. One is the constant pressure exerted to get the job done. The engineer often makes a guess at structural sizes, a guess that is usually conservative.

Handbook standardization was originally planned to relieve the engineer of detailed work so that he would have more time to spend on special analysis. Many designers, however, pick out oversized members in their uncertainty.

The weight of tradition further tempts many engineers. Designs and details of old buildings are constantly being used and reused. And yet such building elements, generally based originally on unstandardized materials and inexact methods of analysis, were purposely given a large safety factor. The owner, not realizing that he is paying for extra strength, accepts this waste of materials, believing that scientific laws are so clearly stated that all engineers arrive at the same conclusions.

Safety factor has been defined as "a fraction denoting the ratio between the maximum load carrying capacity and the design load." When this fraction is greater than 1.0, the structure is safe, and when it is less than 1.0, the structure is unsafe.

Keeping the safety factor down

Because of the uncertainties to be found in most designs, safety factors between 2.0 and 4.0 are commonly used. Sometimes these high factors are justified. However, to keep safety factors at a proper level, the designer should ask himself the following questions: (1) Are the live-load assumptions conservative? (2) Have the physical strength characteristics of the material been overestimated? (3) Is the stress analysis overly cautious? (4) Has the quality of the workmanship been properly evaluated?

It is true that many indeterminants still remain in structural design. Nevertheless, by experience, civil engineers should be able to prophesy future loadings with a fair degree of accuracy. Today, steel sections are accurately rolled, lumber is stress graded, and concrete mixes are tested. With an intelligent appraisal of available laboratory data, the engineer can closely approximate the physical characteristics of the materials of construction.

As for stress analysis, we have available techniques of design that far surpass those of a few decades ago. They are well publicized and have been reduced to workable form. Quality of workmanship, while difficult to control, is not a complete unknown.

Three suggestions offered

To overcome this all too prevalent practice of overdesigning structures, the following suggestions are offered:

1. **The engineering societies** should undertake two studies. First an appraisal should be made of existing knowledge. What do we know? What don't we know? We are constantly adding to our facts and this search for knowledge is essential, but the practicing engineer is often confused by this continuous flow of information. Second, the case histories of thousands of existing structures should be studied. They represent a laboratory of great value. Reports of these findings would have a ready cash market among engineers. Professional and technical groups should be commended for their accomplishments in advanced analysis, but in many cases the engineer who has to design the actual structure has been neglected.

2. **Technical and professional periodicals** should feature more articles on economical designs and details, discussing the more common, everyday structures. We all enjoy reading about the skyscrapers and the suspension bridges, but the average engineer would appreciate articles on the "bread-and-butter" jobs, which after all make up the bulk of his work.

3. **Engineers** should continually endeavor to keep up to date on the progress made in their fields by reading the publications made available to them. They should also catalog their experience in a notebook. This systematic approach to the problem of retaining what one has learned is well worth the trouble.

These suggestions, it would seem, if followed, should lead to economical engineering. Let's take the guesswork out of design, with its resulting waste.

ULTRA-MODERN CONSTRUCTION

M. H. SLOCUM, Director of Construction and Plant Design

Characterized as one of the toughest construction jobs recently undertaken anywhere in the world, Bhakra Dam in Punjab State, India, is proceeding on a tight schedule with the help of American equipment, methods and techniques. The plan for construction of this 700-ft-high dam was prepared by Harvey Slocum, recently named by New York construction men of The Moles as the "best dam man in the world." According to S. D. Khungar, general manager of the work and Secretary to the Government of Punjab, Mr. Slocum has been the guiding spirit behind the construction organization, and is in large measure responsible for the good progress on the dam. The authors here describe this mammoth project and the nature of the equipment mobilized for its construction.

On Sutlej River,
Maximum recorded flood, 375,000 cfs

Irrigated area,
6,500,000 acres

Dam:
Straight gravity concrete
Height, 700 ft
Volume of concrete, 5,400,000 cu yd
Two diversion tunnels of 50-ft diameter, each $\frac{1}{2}$ mile long
First diversion, November 1954

Reservoir:
Capacity, 7,400,000 acre-ft
Usable storage, 5,700,000 acre-ft
Storage to begin in 1958

Power:
Initially, one plant, of five 93,000-kw units; ultimately, second plant of four 93,000-kw units
Firm power, 400,000 kw at 100-percent load factor

Construction of dam:
Started November 1953
Excavation, 7,000,000 cu yd
Concrete mixing plant capacity, 7,000 cu yd per day
First concrete placed, Nov. 17, 1955
Schedule for concreting, 1,000 working days
Completion scheduled for early 1960

A mammoth multipurpose project, called the Bhakra Nangal Project, is under construction on the River Sutlej by the Public Works Department of Punjab State, India. The project comprises construction of a dam 700 ft high (it can be higher, and no doubt will be) with two powerhouses, a dam 90 ft high for after-bay regulation and diversion, a hydroelectric canal 40 miles long, with a capacity of 12,500 cu ft per sec (cfs) with two powerhouses, and a network of irrigation canals. The project will provide perennial irrigation for 6,500,000 acres of desert and semi-desert areas of Punjab, Pepsu, and Rajasthan States in northwest India. The firm power output, estimated at 400,000 kw at 100-percent load factor, will be developed in stages. The canals have already been completed and are in operation for about four months in summer. Construction of the dam is in full swing. It is expected that partial storage will be available in 1958, when the canals will be put into year-round operation. The dam will be completed in all respects by early 1960.

The River Sutlej has a catchment area of 22,000 sq miles at the dam site. As shown in Fig. 1, it rises in Tibet near the famous Lake Mansrover at an elevation of 15,000 ft and flows approximately 200 miles before it reaches the border of India. Numerous glaciers, large and small, drain into it at various points along its course. This river has been gaged continuously since 1912. The mean annual runoff is about 14,000,000 acre-ft, the minimum ever recorded being 9,090,000 acre-ft in 1944. The river discharge drops to about 4,000 cfs in the cold weather and rises to a steady flow of about 50,000 cfs in the hot month of June on account of melting of snow in the higher parts of the watershed. During the Monsoon period, July to September, there are occasional heavy rain storms in the catchment area and the river is subject to frequent floods. Eight times in the past 44 years floods of over 200,000 cfs have occurred, and the highest of record was 375,000 cfs.

A number of canals, having an aggregate capacity of about 27,000 cfs, take off from the river and utilize much of its flow, but from May to September there is considerable surplus, which will be stored in the reservoir for release in the dry period. The reservoir will have a gross capacity of 7,400,000 acre-ft. Dead storage, reserved to maintain the minimum head on the turbines and for silt detention, amounts to 1,700,000 acre-ft, giving a variation of 240 ft from the maximum to the minimum head on the turbines.

The dam site is 220 miles north of Delhi in a narrow canyon in the foothills of the Himalayas, called the Siwalak Hills. The dam is founded on massive sandstone which has a downstream dip of about 70 deg and a strike approximately parallel to the axis of the dam. A claystone stratum, approximately 30 ft thick, cuts the foundation near the middle. Claystones of much greater thickness, which cross the canyon above and below the dam site, to a great extent dictated the location of the structure.

Each of the two concrete-lined tunnels for river diversion are 50 ft in diameter and about a half mile long. Two

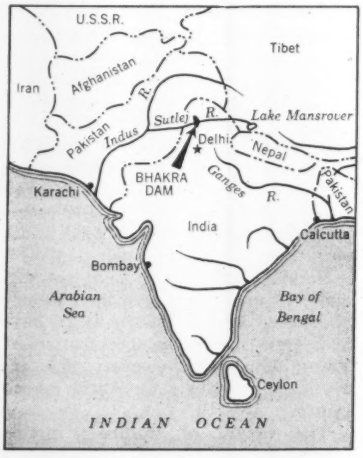


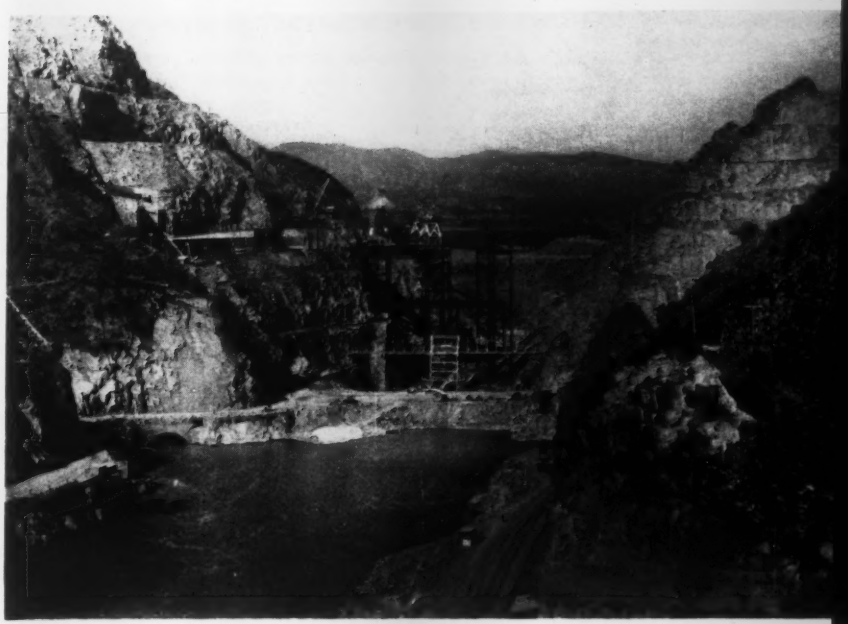
FIG. 1. Bhakra Nangal Project is located in foothills of Himalayas in Punjab.

PLANT *for concrete dam 700 ft high in Punjab*

B. R. PALTA, Superintending Engineer, Plant Design, Bhakra Dam Project, Nangal Township, Punjab, India

cofferdams of rolled earth fill will keep the site dry. The upstream cofferdam, with its top at El. 1305, is 215 ft high, and the downstream cofferdam, with its top at El. 1210, is 133 ft high. Originally these cofferdams were designed to take care of a flood of 250,000 cfs with a frequency of once in 21 years. However during construction it was considered advisable to raise their heights so that the maximum recorded flood of 375,000 cfs could be passed through the diversion tunnels without overtopping them. Therefore the upstream cofferdam was raised 45 ft and the downstream cofferdam, 10 ft.

The top of the straight gravity concrete dam is at El. 1700 and the maximum normal water surface at El. 1680, as shown in Fig. 2. The downstream face has a slope of 0.8 horizontal to 1 vertical. The upstream face is vertical from the top down to El. 1350, below which the slope is 0.35 horizontal to 1 vertical. The lowest foundation level is at El. 1004. The upstream and middle claystone strata are however to be excavated to Els. ±940 and ±1000



Bhakra Dam is under construction between two cofferdams. Upstream cofferdam, in distance (above), beyond trestles and cranes for placing concrete, is actually a rolled earth-fill dam 215 ft high, designed to divert flood of 375,000 cfs without overtopping. Downstream cofferdam, 133 ft high, is seen in foreground, punctured at left by one of two diversion tunnels, each of 50-ft diameter. One of these tunnels is seen under construction in photo at left.

respectively and backfilled with concrete. The maximum base width of the dam will be about 617 ft, and the total width from the upstream to the downstream end to be covered with concrete will be 1,300 ft. Crest width, including roadway and parapets, will be 39 ft. At bed level, the width of the canyon is about 250 ft, and the length of the dam at the crest will be about 1,700 ft. Upstream and downstream elevations are shown in Fig. 3.

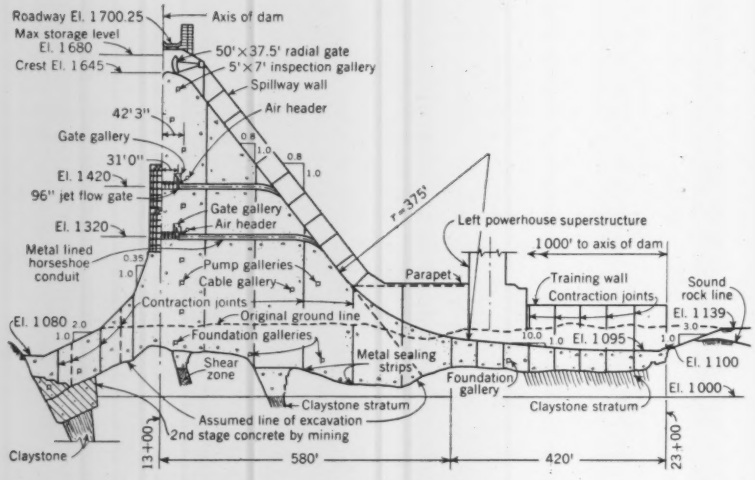


FIG. 2. Maximum spillway section of Bhakra Dam shows location of gates, valves, galleries, and powerhouse. Note foundation problem.

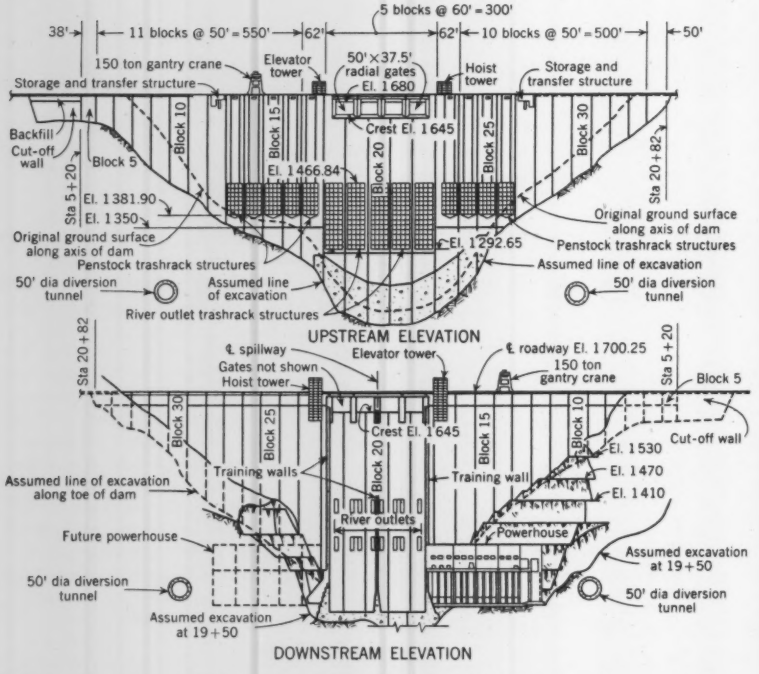


FIG. 3. Elevations of Bhakra Dam indicate locations of diversion tunnels, powerhouses, and outlet works.

In plan, the dam is divided into blocks extending from the upstream to the downstream face, and the transverse contraction joints between these blocks are either 60 ft or 50 ft apart. Longitudinal contraction joints subdivide these blocks into monoliths. The longitudinal joints are generally 98 ft apart and are staggered with respect to adjacent blocks. Keys of conventional shape are provided for interlocking joints. All joints are to be grouted.

An overflow spillway, controlled by four radial gates 50 ft × 37.5 ft, will be provided in the river section. An apron of hydraulic-jump type, 420 ft long will dissipate the energy of the falling water. The minimum thickness of the apron will be 40 ft on the claystone and 20 ft on the sandstone.

Outlet works will consist of 16 horseshoe-shaped, steel-lined conduits passing through the spillway section of the dam in two tiers at Els. 1320 and 1420. Outlets will be controlled by means of 96-in. jet-flow gates, operated from galleries inside the dam. Two fixed-wheel emergency unwatering gates will be provided to permit closure of the outlets at the upstream face for inspection and repair of the jet-flow gates.

Two powerhouses will be located symmetrically, one on the left bank and one on the right bank of the river immediately below the dam. The power plant on the left side (looking downstream) will be developed first. It will have five units of 93,000-kw capacity each. Each unit will be supplied with water by its own steel-lined penstock of 15-ft diameter passing through the body of the dam and thence to the concrete-lined tunnel of the powerhouse. Flow through the penstocks will be controlled by wicket gates and individual fixed-wheel gates at the upstream face of the dam. Stoplogs will be provided to permit inspection and repair of the fixed-wheel-gate guides and seat seals. The powerhouse on the right side will be similar to that on the left except that it is expected to contain four units instead of five.

Mechanized excavation equipment

A total of about 7,000,000 cu yd of excavation is involved in the dam and appurtenant works, including the two powerhouses. In November 1954, the Sutlej River was diverted through the right-hand tunnel. Before this, excavation for the dam had been necessarily restricted to stripping the canyon walls. Stripping of the left abutment was started in November 1953, and that of the right abutment in May 1954. On both abutments, hydraulic sluicing was done to clear the canyon walls of over-

Indian workmen excavated abutment rock with pneumatic hammers (above). Upstream claystone was excavated and removed by conventional shovel and truck of U. S. make (above). At peak of excavation, 11 power shovels and 47 dump trucks were employed.

burden and loose rock. Water from the river was pumped by high-pressure pumps to above El. 1500 and then directed onto the overburden under a pressure of 300 psi through hydraulic monitors. The high-pressure jet sluiced a considerable amount of loose material down the canyon slopes and into the river below, whence it was washed away by high floods.

Special blasting gelatin, 75-percent strength, manufactured by the Imperial Chemical Industries (India) Ltd., is used for excavation. The various rows of holes are delayed by millisecond detonators so that the rows will follow one another and the sound rock will not be disturbed. Approximately half a pound of explosive is used per cubic yard of excavation.

At the peak of excavation 11 power shovels with a total capacity of 30 dipper yards were employed for loading the blasted rock into a total of 47 end-dump trucks—20 of 20-ton capacity and 27 of 15-ton capacity. The muck is hauled about a mile and spread by bulldozers.

Concrete carefully controlled

The work of concreting was started with great rejoicing on November 17, 1955, when the first bucket was placed by Prime Minister Jawaharlal Nehru. Nearly 5,400,000 cu yd of concrete are to be manufactured, transported, and placed to complete the dam and appurtenant works. The basic consideration in the design of the concrete for the dam was to provide adequate strength, durability, and structural integrity at the lowest possible cost. Considerable research on the subject was carried out in the United States and definite standards were set up. The plant at Bhakra was designed to embody all the latest practices used in the United States and can be rightly classed as one of the most modern and efficient plants in the world for the manufacture and placing of concrete.

Mass concrete in the dam is divided into two classes—interior and exterior. The former, proportioned on the basis of 2.75 bags of cement (1 bag = 94 lb) per cu yd and 6.8 gal of water per bag (water cement ratio = 0.60) is designed for a strength of 2,300 psi at 28 days. The exterior concrete, proportioned on the basis of 4.2 bags of cement per cu yd and 6 gal of water per bag (water cement ratio = 0.52) is designed for a strength of 3,000 psi at 28 days and will be used on the upstream and downstream faces for an average thickness of 6 ft. However, the concrete in the spillway section is designed for a strength of 4,000 psi for the top thickness of 3 ft.

An air-entraining agent, consisting of 10 percent vinsol resin solution, is used for improving the workability, cohesiveness, homogeneity, and plasticity of the concrete. Furthermore it is proposed to use pozzolana to replace 20 percent of the cement. Laboratory experiments show that locally available shale can be profitably calcined into suitable pozzolana. A plant to produce it is being set up.

Specifications require that the concrete in the dam be placed at 60 to 65 deg F. In the spillway, where contraction joints are not to be grouted, the prescribed temperature for concrete is 50 to 55 deg F. All concrete is to be placed in 6-ft lifts. The minimum time interval permitted for placing concrete in two successive lifts is 72 hours. Mass concrete is to be cooled by circulating cold river water during the winter months through cooling pipes embedded in the concrete at every lift. These pipes will be of 1-in. diameter, 16 gage.

Each day saved in the construction of the dam brings nearer the fruits of the project, and therefore, 1,000 working days only have been allowed for concreting the dam, an average progress of 5,000 cu yd per day. The plant is designed for a peak progress of about 7,000 cu yd per day. This is the minimum time in which a dam of this magnitude can be constructed, and except for a few dams in the United States, the planned rate of progress is the highest on record in the world.

Belt conveyors move aggregate

Raw material for aggregate is obtained from natural river deposits near Neilla and Fatehwal villages, situated about 3 and 5 miles respectively downstream from the dam site. These are typical water-borne deposits of well rounded particles of excellent quality. It is estimated that about 12,000,000 tons of aggregate will be excavated to complete the work. The construction plant is shown in Fig. 4.

The aggregate at Fatehwal is being excavated by one 5-cu yd electric shovel and two $2^1/_2$-cu yd draglines. One $1^1/_2$-cu yd shovel is used for removing overburden. The excavated aggregate is loaded into 15 rear-dump trucks, of 15-cu yd capacity, through a portable grizzly designed to reject all cobbles larger than 7 in. in size. The rear-dump trucks discharge into a hopper with a vibrating feeder, which in turn loads a 42-in. conveyor belt leading to a surge pile with a capacity of about 15,000 tons.

At Neilla the procedure for aggregate recovery is similar to that at Fatehwal. The equipment consists of one $3^1/_2$-cu yd shovel and one 3-cu yd dragline.

During the trial runs at Fatehwal and Neilla, it was noticed that cobbles bigger than the 7-in. size found their way into the surge piles in spite of the grizzlies. To remedy this, scalping units were in-

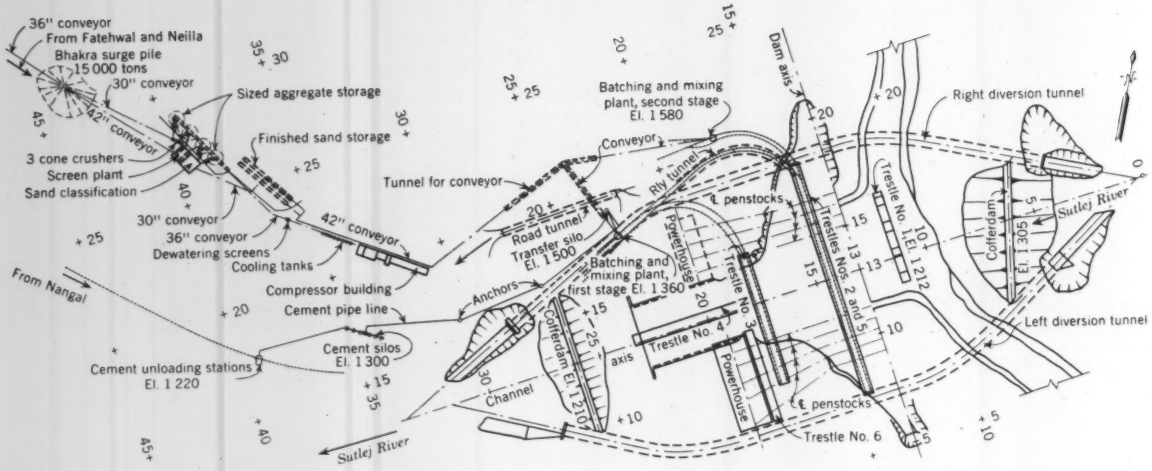


FIG. 4. Plan shows layout of modern construction plant with its belt conveyors, as well as trestles used in dam construction.

One of two sources of aggregate material is at Neilla (above), 3 miles downstream from dam site. There suitable natural river deposits are excavated by shovels and draglines, screened, crushed, and transported by belt conveyor to Bhakra. Aggregate belt-conveyor crosses Sutlej River on suspension bridge of 784-ft span (below).

stalled at both sites. Furthermore, analysis of classified material at Bhakra showed a deficiency in the size from 3 in. to 7 in. Consequently a crusher was installed at Neilla, fed from the reject chute of the scalping plant by a belt conveyor. Another belt returns the crushed material to the main belt.

Aggregate from the surge pile at Fatehwal, on the right bank of the river, is first conveyed to the Neilla surge pile on the left bank by a system of 30-in. conveyor belts, 7,000 ft long, in five flights. This belt conveyor crosses the river on a suspension bridge with a main span 784 ft long. To transport the aggregate from Neilla to the surge pile at Bhakra, a 36-in. conveyor nearly 10,000 ft long, consisting of 11 flights, is used. Design data for the belt conveyor system from Fatehwal to Bhakra is given in Table I.

All multiple-flight conveyors are electrically interlocked. If any flight in a system fails, all preceding flights stop automatically. All points of transfer have an independent telephone connected to the control station for the conveyor system.

Belt conveyors are widely used at Bhakra Dam on account of the huge quantity of material to be handled, the rugged terrain, the limited working area, and the considerable difference in elevation between the aggregate quarry and the batching and mixing plant. For these reasons conveyors are the most efficient and economical method of transportation.

Aggregate closely classified

The specifications require that the coarse aggregate be graded. The opti-

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Concrete materials plant is on right bank just downstream of dam site. Cement is pumped to silos in left foreground from small bulk rail cars out of photo at left. Aggregate arrives by conveyor at classification plant in left center (seen in close-up at left). Thence it is distributed to stockpiles and by reclaiming tunnel is fed as needed by conveyor to cooling silos in center building. It then moves by housed conveyor to concrete mixing plant out of upper photo at right (but seen in close-up below). This mixing plant, which can produce 320 cu yd per hour, will be moved 220 ft higher up for concreting upper part of dam. See Fig. 4.

TABLE I. · Belt conveyor system for transporting aggregate from Fatehwal to Bhakra

Conveyor No.	Max. Lump Size, in.	Belt Width, in.	Capacity, tons per hr	Speed, ft per min	Horizontal Length, ft	Max. Lift, ft
1	+7	42	900	430	688	+95
2	+7	42	900	430	380	97
2A	+7	30	75	250	330	40
3	7	30	600	490	1,658	−15
4	7	30	600	490	1,906	8
5	7	30	600	470	1,105	−17
6	7	30	600	490	2,006	26
7	7	30	600	510	290	56
8	7	36	600	470	235	59
9	¾	30	300	270	160	39
10	7	30	500	440	330	85
11	7	36	750	480	1,206	70
12	7	36	750	490	768	119
13	7	36	750	500	2,878	−140
14	7	36	750	480	1,986	33
15	7	36	750	470	640	36
16	7	36	750	490	738	102
17	7	36	750	490	±300	35
17A	7	36	750	490	±641	139
17B	7	36	750	490	±250	−19
18	7	36	750	480	±250	56
19	7	42	950	500	600	105

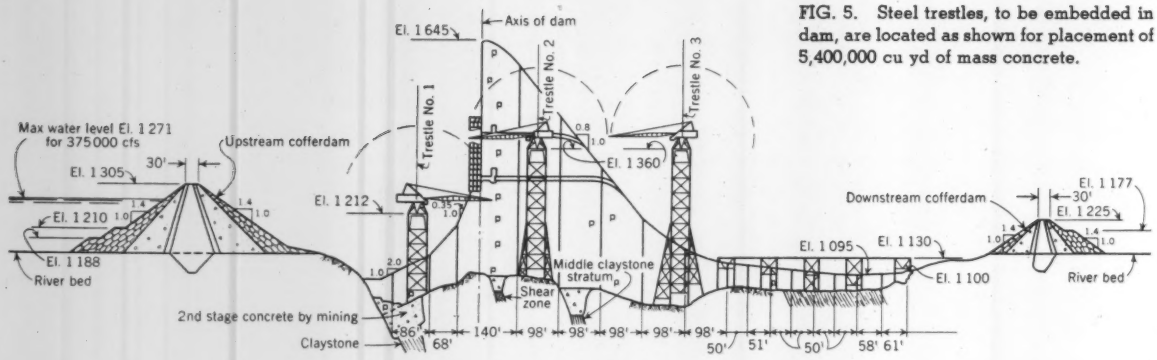


FIG. 5. Steel trestles, to be embedded in dam, are located as shown for placement of 5,400,000 cu yd of mass concrete.

mum grading for aggregate for the mass concrete, as determined by laboratory tests is as follows:

Size, in.	Percentage by weight
3/16 to 3/4	18 to 22
3/4 to 1 1/2	22 to 25
1 1/2 to 3	25 to 28
3 to 7	28 to 35

As for the sand, it also must be graded and have a fineness modulus of not less than 2.20 nor more than 2.50. Specifications require that the fineness moduli of at least 9 out of 10 consecutive test samples of finished sand, taken hourly, must not vary more than 0.20 from the average fineness modulus of the 10 test samples.

For preparing the finished aggregates, a modern processing plant with a capacity of 950 tons per hour has been installed at Bhakra at El. 1400. From the surge pile at Bhakra, of 15,000-ton capacity, the raw aggregate is reclaimed and conveyed by a 42-in. conveyor to the top of the classification plant which is 115 ft high. Thence it is discharged into a surge bin of 20-ton capacity with two magnetic feeders. The raw aggregate is subjected to two stages of wet screening. The first is accomplished by two 6 × 12-ft double-deck screens which separate out the 3-in. cobbles. The second stage has four 5 × 12-ft double-deck screens and separates out 1 1/2-in. rock and pea gravel. The wash-down consists of sand, clay, slime, and water.

The raw sand is washed and deslimed in two 8 × 30-ft rake-type classifiers. The product of one rake classifier is taken without further processing to the sand pile, while the product of the other is first screened through an 8-mesh screen and then fed to a bank of four sizers. When the unwanted sizes have been wasted, the sizer product and the screen product are dewatered by another rake-type classifier, and the finished sand is delivered to the sand conveyor system. The sizers have produced sand of specified grade in an excellent manner.

All equipment is electrically operated and has modern push-button remote controls which interlock so that a definite sequence is followed to prevent damage to machinery and injury to personnel. Considerable operating flexibility has been engineered into this plant so that aggregate of consistent quality can be processed over a fairly wide range of settings.

Coarse aggregate precooled

Finished aggregate is moved from the storage piles to the cooling plant on a 36-in. belt and discharged onto a shuttle belt. Here it is cooled by inundation in circulating precooled water. The plant consists of 8 tanks with a capacity of 120 cu yd each, which are fed in turn by the shuttle belt. The complete cooling cycle requires 90 minutes, made up as follows: 10 min for filling the tank approximately one-third full of water; 15 min. for filling the tank with aggregate and water; 35 min for cooling the aggregate by circulating water, the temperature of which is adjusted according to that of the surroundings; 15 min for draining the water from the tank; and

Concreting was started with great rejoicing on November 17, 1955. Total of nearly 5,400,000 cu yd is to be placed in 6-ft lifts at average progress of 5,000 cu yd a day, to bring project to completion early in 1960. In photo at left, below, double cantilever crane with span of 320 ft, in foreground, places concrete in spillway apron from Trestle No. 4. In background is Trestle No. 3 under construction. Revolving crane mounted on it can handle concrete buckets at radius of 150 ft.

15 min for discharging the cooled aggregate from the tank to the belt conveyor.

The water cooling equipment consists of three ammonia compressors, four coolers of 48-in. diameter, and a chilled-water tank of 210,000-gal capacity. There are two coolers of 30-in. diameter for supplying chilled water to the batching and mixing plant. The cooling plant has a total refrigeration capacity of 1,400 tons. After inundation, the aggregates are drained, passed over vibrating screens to remove excess water, and carried to the top of the batching and mixing plant on a 42-in. belt. To maintain the low temperature of the aggregates until they are delivered to the mixing plant, the cooling plant and the belt conveyors are housed in insulated structures.

Nearly 800,000 tons of cement will be required for the foundation grouting and concreting of the dam. The cement, manufactured at the Bhupindra Cement Works, Surajpur, is transported by railway a distance of about 130 miles in specially designed bottom-dump hopper cars each having a capacity of 20 tons. Three train loads of cement will be hauled daily to meet the peak demand of about 1,000 tons per day. The cars dump into track hoppers located at the railway terminus at El. 1220, about 1,500 ft downstream of the dam site (Fig. 4). From here, two pumps with a capacity of 60 tons per hour each move the cement into any of the six cement silos (of 840-ton capacity each) installed at El. 1300. From these silos the cement is pumped into a transfer silo (of 840-ton capacity) located at El. 1500. The transfer silo feeds the batching and mixing plant (at El. 1360 for the first stage) by means of an air slide. The entire cement pumping operation is electrically controlled.

The batching and mixing plant, housed in an octagonal steel structure, consists of four 4-cu yd mixers, a bin of six compartments with an overall capacity of 1,250 tons, a pivoted distributor at the top for spilling the classified aggregate into the compartment of the bin reserved for that size, and automatic weight batchers. Equipped for automatic operation, the plant has all the modern features required for close control of weighing and mixing. One man operates the mixing plant from the control point. The mixing time allowed is $2^1/_2$ min and the maximum capacity of the plant is 320 cu yd per hr.

The plant is located on the right bank at El. 1360 for the first stage of concreting. For the second stage, it will be reerected at El. 1580.

Concrete placed from steel trestles

Concrete is being placed in the dam by cranes working on steel trestles. The first stage envisages construction of the dam up to El. 1360, involving placing of 3,000,000 cu yd of concrete. Three trestles aligned parallel to the dam axis are being erected. (See Figs. 4 and 5.) Trestle No. 1, with its top at El. 1212, covers the dam upstream of the axis and the upstream claystone, which is to be excavated and backfilled with concrete. Trestles Nos. 2 and 3, with their tops at El. 1360, will be used for placing the concrete in the main dam. Trestle No. 4 with its top at El. 1130, has been erected at right angles to the axis of the dam for placing concrete in the spillway apron and training walls. Trestle No. 5, actually a continuation of Trestle No. 2, will be erected with its top at El. 1580 for concreting during the second stage. A sixth trestle will be required for concreting the left powerhouse.

Trestles consist of standard spans of 64 and 79 ft, supported on towers respectively 36 × 44 ft and 43 × 44 ft. Some towers are as high as 320 ft, which is believed to be a record for this type of structure. The trestles are decked with timber and carry two standard-gage tracks with necessary crossovers for concrete transfer cars, and crane rails 44 ft apart. Three revolving cranes of 26,000-lb capacity at 150-ft radius, and two double-cantilever cranes of 320-ft span and 26,000-lb capacity have been purchased for working on the trestles. Two stiffleg derricks, of 25,000-lb capacity at 185-ft radius, have also been obtained for placing concrete on upstream abutments of claystone. All the cranes are electrically operated.

Concrete from the batching and mixing plant is delivered to points of placement by 11 transfer cars. A transfer car consists of a flat car with four 4-cu yd buckets and space for a spare and is hauled by a diesel electric engine of 80 hp.

Concrete is vibrated by high-frequency electric vibrators. Special motor generating sets, of 10- and 20-kw capacity, generate electricity for these vibrators at 120 volts and 120-cycle frequency.

Steel cantilever forms, fabricated at the site of the work to a design furnished by Blaw-Knox Company, are used on the main dam. Wood panels are used in the spillway apron, galleries, and training walls. Forms are raised by safety-pull ratchet-lever chain hoists and A-frames.

Job facilities unusually complete

For the construction of such a high dam, believed to be one of the toughest projects ever undertaken, all types of equipment must operate at top efficiency—including highway transportation equipment, railways, workshops, powerhouses, transmission lines, excavating units, belt conveyors, cooling plant, mixing plant, and cranes. To achieve this, a force of trained men is required for operation and maintenance, plus a large inventory of spare parts. Since India has not tackled such a huge and intricate job before, all the experienced personnel required is not available there. To get over this difficulty, experienced Americans are working with the Indian personnel and helping them to accomplish the job.

There is a lack of locally manufactured equipment and spare parts for machines. To make up this deficiency, a design office for engineering and well equipped workshops have been set up at the site. Here the steel structures for the belt conveyors—such as the transfer stations, towers, bar joists, cantilever trusses, suspension bridges, chutes, screen house, cement silos, batching and mixing plant, and trestle spans—were designed and fabricated. The 4-cu yd concrete buckets and the steel forms for the dam were fabricated in the project shops according to the design furnished by the Blaw-Knox Co. Penstocks, steel-plate conduit lining, trashracks, and radial gates will also be fabricated in these shops at the site.

Organization and personnel

The organization consists of three directorates—Designs Directorate, Construction and Plant Design Directorate, and Inspection and Control Directorate.

All operations connected with Bhakra Dam and appurtenant works are under the general direction of M. H. Slocum, operating through S. D. Khungar, General Manager and Secretary to the Government of Punjab. Mr. Khungar has over-all administrative charge of the work.

The Designs Directorate, located at New Delhi, prepares designs and specifications for the dam; C. L. Handa, M. ASCE, is the Director. Important designs have been checked by the United States Bureau of Reclamation.

The Directorate of Construction and Plant Design is responsible for planning, layout, design and erection of construction plant, procurement of materials and equipment, and construction of the dam and appurtenant works. M. H. Slocum is Director and M. R. Chopra, M. ASCE, is Joint Director. R. L. Khanna is Director of Inspection and Control.

To ensure efficient and economical execution of the project, a Control Board has been formed, with C. P. N. Singh, Governor of Punjab, as chairman, and with financial and engineering representatives of the central and participating state governments as members. There is also a Consulting Board, consisting of eminent engineers from America and India, which was formed to advise on important technical points.

ARTHUR E. MORGAN, Hon. M. ASCE

President, Community Service, Inc., Yellow Springs, Ohio

TVA—how did it happen?

The TVA began in mid-June 1933, with three directors sitting in a Washington hotel room, with no organization and no equipment. Before the end of September a great dam was under construction. The rapidity and sureness with which the construction work started was due largely to a little group of men who previously had worked together in mutual confidence and understanding. Like an experienced football team entering a new game, they hit the line hard on the first play.

That speed of action answered the need for quick increase in employment in a great depression. Days and years which otherwise would have been spent by many men in compulsory unemployment and personal frustration were turned into enduring and productive work, and those who did that work had the self-respect and pride which come from being a part of something greatly worth while.

That speed was not at the expense of quality. Few construction projects have excelled in quality and economy the building of those first dams. The accidental death rate was but a fraction of that prevailing on similar jobs. It is natural to have respect and affection for the little gang of men who were masters of every phase of the job they undertook, and who gave the TVA a running start.

Especially I want to pay my respects to the memory of the late Sherman Woodward, Hon. M. ASCE, who gave spirit and competence to the entire river planning job, and was the guide and inspiration of the hydraulics program. It will be half a century next year since I began to work with him. I lacked formal engineering training, and he became my guide and teacher as well as my engineering associate. Of about three thousand engineers whom I have employed or supervised, including perhaps a thousand in the TVA, I should put this modest, unassuming man first for clarity of insight in his field.

My years with the TVA covered more than engineering, and it is natural that my mind should range over the project as a whole. I have seen few references to the unusual nature of its origin. Some human developments are in the spirit of the times, and are nearly inevitable, while others could not have been predicted, for there seemed nothing in the historic background to make them probable. For example, Darwin is properly credited with the theory of evolution. Yet that theory would surely have emerged, probably in less than five years, even if Darwin never had lived. It was, as we say, "in the air." On the other hand, Einstein's theory of relativity seemed to be born without parentage in the current thinking. Efforts to find background for his discovery have turned up little.

Various elements of the TVA idea, such as Theodore Roosevelt's movement toward the development of country life and the logic of unified, multipurpose river control, had already been envisioned. But the overall TVA concept, like Einstein's theory, was largely a creative accident of history. If President Franklin D. Roosevelt had not brought the Tennessee Valley Authority to pass under the peculiar circumstances of the time, probably no one else ever would have done so.

Far from conventional democracy

For the TVA to emerge into actual existence required a remarkable coincidence of conditions. Senator Norris was a factor, but his imagination covered far less than the whole. The controlling cause was a President with a remarkable range of creative imagination, readiness to break with social, political, and industrial precedent, and a great concentration of political power. With whatever ideas came from others, the total picture developed in his mind. He told me how in his youthful days he went on horseback through those mountains, his mind recording what he saw. A creative vision of what might be possible, along with a zestful interest in novel achievement and the sudden acquisition of exceptional power, led him to drive through opposition and to bring quick coordinated action in seven stubbornly individualistic states.

The quality of ranging, creative imagination which brought about the TVA was the same as that which led the President, I understand against the judgment of his military advisers, to secretly commit his country to a vast program of daring, speculative research in atomic energy, involving the secret expenditure of many hundreds of millions of public money. In that case the creative mind, Franklin Roosevelt, and the creative mind, Albert Einstein, collaborated, with consequences which may change the course of human history. How Roosevelt must have delighted to meet Einstein! The fact that I found it necessary to part company with the President need not blind me to recognition of a fecund, creative personality.

The course in atomic energy research, taken under exceptional circumstances, did not conform to the methods of conventional democracy. Somewhat the same may be said as to the origin of the TVA. It was initiated from outside the Tennessee Valley area. The people most directly concerned had almost no part in its origin, though with its striking success political memories were revised to claim important parts in its creation.

There was little or no provision in the TVA Act as originally passed for referring decisions on its problems to the people of the region. The spirit of cooperation with states and local agencies resulted largely from the way in which the

Act was administered. The TVA, in the form in which it emerged, was typically a Franklin D. Roosevelt creation, rather than an application of the democratic process. So it has been as to various other actions in our national history, from the Louisiana Purchase by President Jefferson to the dictatorial expansion by fiat of our great national forest system by Theodore Roosevelt. Like Thomas Jefferson, I am deeply committed to the democratic spirit and to the democratic process. Yet over and over we are brought to realize that some achievements we prize highly are difficult to reconcile with that pattern.

America has tended to disregard ideologies. Our fire departments and our public schools have long been communal in their organization and operation. Our municipal water supplies and our post office have been socialistic. Some of our greatest and best-run industries have been private dictatorships. Some of our most honored universities have been private oligarchies with self-perpetuating governing boards, yet often they have been more courageous defenders of academic freedom than some of our public state universities.

The genius of America has had an intuitive recognition that life is too big and too varied to be confined within the shell of any ideology, right, left, or center. Americans incline to use any type of social or economic organization which contributes to the general well-being, though assuming that in the end the people must rule. There is great danger in such pragmatic political philosophy. In fact, there is great danger in being alive, for life is stubbornly pragmatic.

In the organization of its public life, America has not been very creative. New discoveries or creations in the art of government have been few. During the past century the discovery of council-manager government for towns and cities, also a sort of historic accident, has been very fruitful; and the widespread adoption of legislative councils has improved the process of state legislation. Regulatory bodies, perhaps beginning with the Interstate Commerce Commission, might be added to the list. The Port of New York Authority was foreshadowed in the U.S. Constitution. But where else has there been creation or discovery of essentially new methods in government?

Something rare—a new form

The TVA has in it something of a new creation, of new ways for handling some of our common public needs. This has been recognized the world over. Such new ways being rare, when one does appear that has promise we should cherish it to the extent of giving it a chance to disclose its possibilities. To thwart, distort or mutilate it, so that its possibilities may never be fully discovered, may be a historic loss. But also to deify it, to idealize it, to hold it to be above critical and realistic appraisal, may give it place among sacrosanct social dogmas, to be credulously accepted or violently opposed, but not to be subjected to real inquiry.

The TVA has suffered from both these attitudes, and each tends to accentuate the other. Among its more zealous friends it has been a holy political shrine at which to worship. Among its enemies it has been considered as a beachhead for the invasion of evil which if not destroyed may spread and contaminate wholesome national life.

Because of the manner of my separation from the TVA, at various times its enemies have come to me to be briefed in preparation for their attacks. When I would point out where their publicity was factually in error, usually their interest would suddenly disappear. They had come, not for more light, but for more ammunition. There continue to be disseminated, by direct mail publicity of the more right-wing organizations and by advertisements in our national periodicals, unrepresentative, unfair, misleading attacks on the TVA, with the obvious intent of destroying and dismembering it. Such a course is quite different from responsible, discriminating criticism.

On the other hand, the more unreservedly zealous friends of this great undertaking sometimes have disclosed a lack of discrimination. Over the nation, wages for labor today are several times as high as prevailed when the TVA was organized. Some zealous TVA friends are inclined to impute that change as it relates to the Tennessee Valley largely to the influence of the social and political ideology of the TVA. And they seldom mention the fact that the concentrated spending of two billions of public money in what was an economically backward area would have had stimulating effects under almost any probable public policy.

One would scarcely discover from their eulogies that not only the Tennessee Valley but all America has been experiencing an unprecedented increase in total wealth. Electric power rates have steadily declined over the nation for half a century; yet some zealous friends have inclined to impute such reductions in large measure to TVA influence. Such exaggeration is the more unfortunate and harmful because the TVA needs no such defense.

Polemics versus honest inquiry

The habit of substituting polemics for inquiry into the merits of situations is not limited to any single phase of our national life. It tends to become a national obsession. We see in national politics how much effort is spent in trying to put the opposition in a hole, and to win prestige for one's self and one's party rather than to try to discover the merits of the issues. A similar attitude in international affairs has greatly reduced the high regard in which our country formerly was held by the rest of the world. Such a course not only is confusing to the public, making it more difficult to determine present policy, but it has more serious effects. It violates something deep in human nature, betrays the natural craving for self-respect and human dignity, and weakens the democratic process.

Where there is a spirit of mutual respect and of real inquiry, men may differ greatly in their views and interests. Yet as they mutually explore for the merit of a situation, mistaken ideas tend to dissolve, common ground to emerge, and a degree of unity to result.

If that spirit should prevail among partisans for and against the TVA, I have little doubt but that the unrepresentative propaganda concerning the Authority which comes in my mail would soon cease. There is scarcely a phase of our national life or international relations which would not respond to an honest, but hard-boiled and realistic spirit of real inquiry.

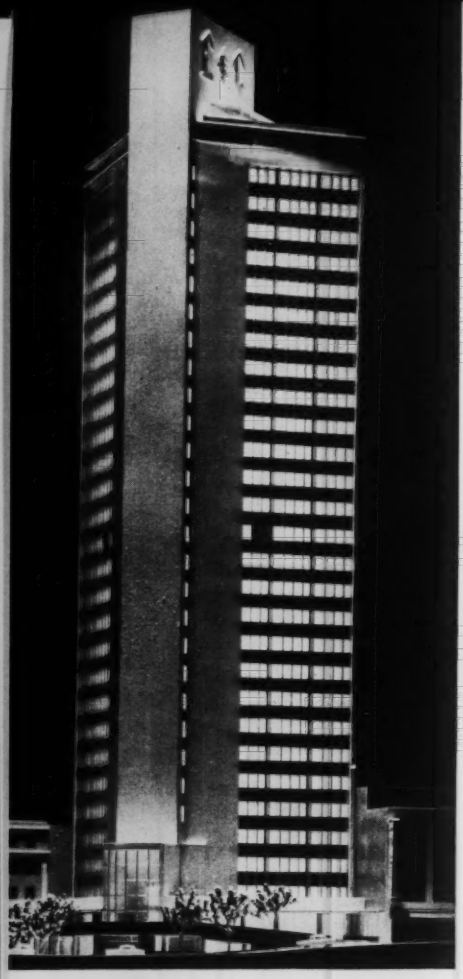
Efforts in good faith to find common ground do not always win. If they did that would be the first principle of human action to have a perfect record of success. But in dealing with reasonably normal men the probability of success by that policy will, I believe, rank above the probability of success by any other course.

When H. G. Wells visited Stalin years ago and criticized his methods, Stalin responded that the trouble with Wells and with the West was that they did not understand human nature. Such a view of human nature is very common among men who feel that appeal to reasonableness is futile and that the only sure recourse is to cynical strategy and power. Let us hope that Stalin's appraisal of human nature will not prevail in the long run in America.

It is a pleasure to address a group of hydraulic engineers. It is their work to find and to present the significant facts, whatever their inference may be. As I have kept somewhat in touch with the hydraulic and river control work of the TVA, so far as I know, it has well sustained that ideal. And may it continue to do so through a long life.

(Mr. Morgan's address, here given in shortened form, was originally presented at the ASCE Knoxville Convention, before the Hydraulics Division Dinner, at which Joseph B. Tiffany, Chairman of the Division's Executive Committee, presided.)

TRUSSED FRAMING STIFFENS

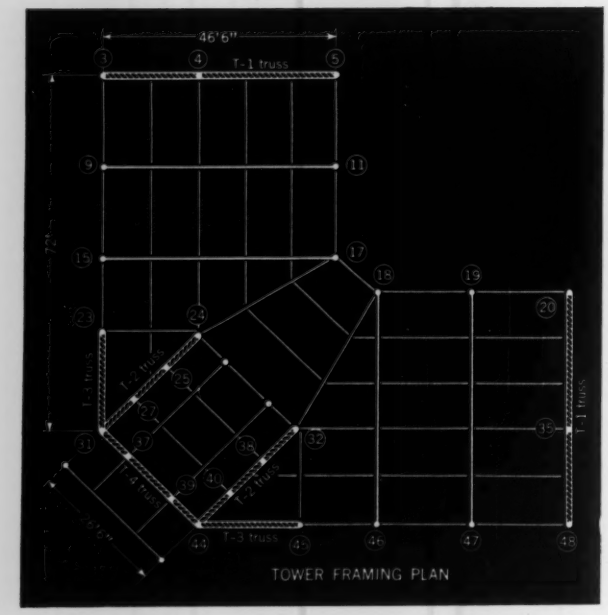


Front elevation of model gives an idea of completed structure.

The structural problems encountered in designing the 30-story office building in Nashville, Tenn., for the Life and Casualty Insurance Company, were somewhat different from those usually encountered in a structure of this type. These unusual problems arose because of the ratio of height to width of the structure and the absence of interior columns above the ninth floor. The height from the basement to the penthouse roof is 420 ft, and the width of the tower section above the ninth floor is 47 ft. It is evident that such a ratio of height to width would produce large wind moments in the beams and columns and excessive distortions in the beam and column panels unless very deep wind connections were used.

The structural steel frame is connected with high-strength bolts. All main members are designed for semi-rigid connections. The floors are of cellular steel with lightweight concrete fill. Exterior walls are faced with stone and backed up with clay tile. The windows have continuous aluminum sunshades extending vertically the full height of the building, with aluminum spandrel panels under the windows.

A preliminary study indicated that the permissible maximum deflection of the building under wind load should be approximately 8 in. if panel distortions were to be held to a value which would avoid excessive cracking of interior walls and partitions. A further investigation indicated that if typical beam-to-column wind connections were used, the calculated deflection of the building would greatly exceed the required minimum. It was therefore decided that vertical cantilevered trusses would be used to resist the wind shears. It was required that the location of these trusses fit into the fenestration of the building and yet be located so that interaction between the trusses could be



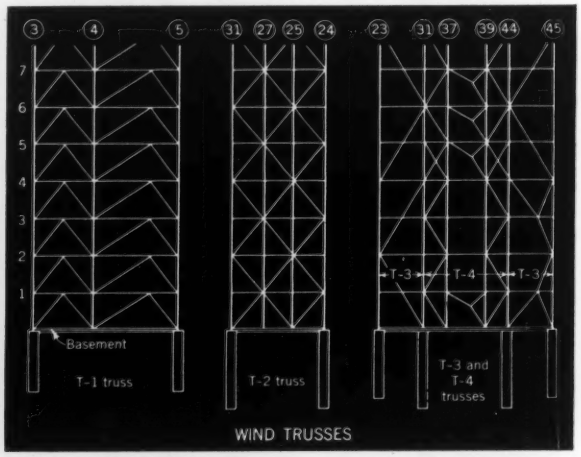


FIG. 1. Tower framing plan and four types of wind trusses show design of structural frame. This 30-story building is 420 ft high from basement to penthouse roof. Above ninth floor, tower is only 47 ft wide, giving low width-to-height ratio.

TALL, SLENDER BUILDING

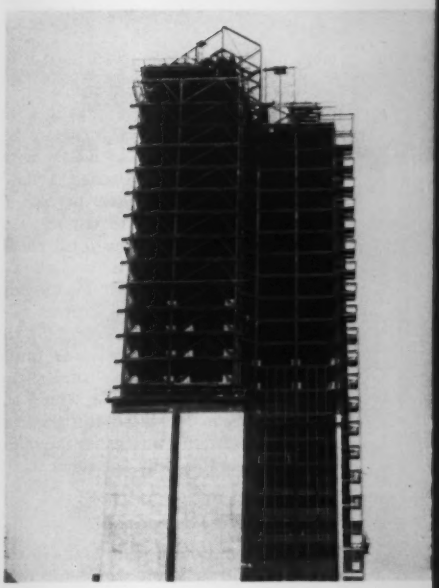
ROSS H. BRYAN, M. ASCE
Consulting Engineer, Nashville, Tenn.

relied upon. Five such trusses were located in wall areas where a minimum number of openings occurred. Two of these trusses were placed in property-line walls in which only corridor windows occurred. The three remaining trusses were located in the walls of the elevator banks and the stair tower.

A typical tower framing plan showing the location of the wind trusses is given in Fig. 1. Trusses marked T-1 are in the masonry walls of adjacent property lines; the T-2 trusses are at the back side of each of the elevator banks; and trusses T-3 and T-4, designed to act as a single truss, are located across the front of the elevator banks. These trusses form a bent plane, and the transverse forces resulting from their action in this plane are taken by trusses T-2 as an addition to their calculated wind loads.

Unity of action of the five trusses is enforced by means of a horizontal bracing system located in every third floor. This bracing system is designed to transmit the total wind shears of three stories even though some distribution of these shears could reasonably be assumed to be taken by the intermediate floors, in which the cellular steel construction is welded to the floor beams.

The determination of the proportion of wind shears to be carried by each of the wind frames was a problem that required considerable study. Approximate forces acting on the individual frames were determined by taking moments about points of intersection of two frames, using the depth of the frames as a measure of their stiffness. From these studies approximate column sizes were determined. Using approximate sizes thus obtained, the moment of inertia of each of the frames was recalculated and a center of rotation established for the action of all frames. Surprisingly



View of side elevation shows T-1 truss above finished stonework.

← Rigid frames span entire 47-ft width of tower, with no interior columns. Note connection of rigid frame to exterior column.

Anchorage columns, with spiral wrapping attached (photo at left), were anchored at depths varing from 20 to 25 ft. For each anchorage, hole of 3-ft diameter was drilled into limestone (photo above). Bond of 50 psi was assumed because of roughness of hole.

enough, it was found that the preliminary and final analyses agreed rather closely. After the center of rotation had been established, maximum shears for each of the frames were determined by varying the direction of the wind until the combined effect of shear and torsion was a maximum. It was found that maximum stresses occurred in all the frames when the wind was blowing parallel to one of the two major axes of the building.

As shown in Fig. 2, the X-axis was taken as bisecting the angle formed by the two tower sections. The Y-axis was taken through the center of rotation, perpendicular to this axis. It was found that the maximum stresses in frames T-1 and T-2 occurred with the wind blowing parallel to the X-axis. Trusses T-1 were found to carry 32 percent of the total wind shear, and trusses T-2, to carry 26 percent of the total shear. The maximum stresses in trusses T-3 and T-4 occur when the wind is blowing parallel to the Y-axis. Trusses T-3 were found to carry 21 percent of the total shear and Truss T-4 was found to carry 41 percent of the total shear. Truss T-1 was the only case where the effect of torsion increased the shear in the frames. In all other cases the effect of torsion was to reduce the shear in the frames.

Wind analysis summarized

The distribution of wind loads in this indeterminate structure was determined to be as follows:

Let F_1 be the shear in T-1; F_2, that in T-2; F_3, that in T-3; F_4, that in T-4; and F_c, that in the cluster of T-3 and T-4 acting as a unit.

In truss T-1, the wind stress will be at the maximum when the wind is blowing parallel to the X-axis. Then $F_1 = 0.32 \times F_x$.

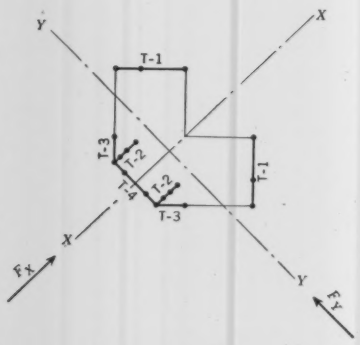


FIG. 2. For determination of load distribution factors, X-axis was taken as bisecting angle formed by two tower sections, and Y-axis perpendicular to it.

The shear distribution is as follows:

Panel 3-4 = $0.375\ F_1$
Panel 4-5 = $0.625\ F_1$

In truss T-2, the maximum stress will occur when the wind is blowing parallel to the X-axis.

$$F_2 = 0.477 \times F_x \times 0.545 = 0.26\ F_x$$

The shear distribution to all the panels (31-27, 27-25, and 25-24) can be assumed as equal to $\frac{1}{3}\ F_2$.

In truss T-3, the maximum stress occurs when the wind is blowing parallel to the Y-axis.

$$F_3 = (0.206 - 6.5 \times 0.0026)\ F_Y$$

Use $F_3 = 0.21\ F_Y$.

In truss T-4, the maximum stress occurs when the wind is blowing parallel to the Y-axis.

$$F_4 = (0.410 - 6.5 \times 0.0057)\ F_Y = 0.37\ F_Y$$

Use $F_4 = 0.41\ F_Y$.
The shear distribution is as follows:

Panels 31-37 and 39-44 = $0.26\ F_4$
Panel 37-39 = $0.48\ F_4$

In trusses T-3 and T-4, to find the column stresses, assume that the wind is blowing parallel to the Y-axis.

H_c = total shear on trusses T-3 and T-4 parallel to Y-axis
$H_c = 0.70\ F_Y$; $M = H_c \times h$.

The maximum column stresses are found to be:

Col. 23 = $0.015\ M$
Col. 31 = $0.0138\ M$
Col. 37 = $0.00172\ M$

The design of trusses T-3 and T-4 was considerably complicated by the necessity of bending the framing around openings in stair and elevator areas. On several floors it was necessary to eliminate diagonal members altogether in truss T-4. The entire shear of this truss was assumed to be carried by the flanking T-3 trusses. This required a very heavy diagonal member in the T-3 trusses between the second and fourth floors. The location of the diagonal members in the T-1 trusses in some cases was shifted off center in order to miss framing for windows at the ends of corridors.

As might be expected, considerable uplift was encountered in designing the foundations for the wind trusses. The main chord members of all the trusses are subjected to uplift which varies from 800 to 1,700 kips under an assumed condition of dead load plus wind.

To resist the uplift in the main chords of the wind trusses, the members were extended down into circular holes of 3-ft diameter drilled into bedrock. The depth of embedment varied from 20 to 25 ft. The anchorage columns were wrapped with $\frac{1}{2}$-in. spiral wire with a 4-in. pitch before being lowered into the holes. After the anchorage columns were in place, the holes were filled with 5,000-psi concrete.

The drill-hole depth was determined by extending each hole to the depth at which it would pick up a cone of rock equal in weight to $1\frac{1}{2}$ times its calculated uplift. The slope of the sides of the cone was assumed to be 45 deg. The shear on the surface of the drill hole was taken as 50 psi. The surface of the hole itself was fairly rough and corrugated in texture. It was decided that a bond of 50 psi could be safely depended on, in view of this roughened condition of the surface of the drill hole, as shown in a photograph.

No interior columns above ninth floor

A feature of the building which added to the problem of designing for wind shears was the elimination of all interior columns above the ninth floor. A study was made to determine the probable cost of removing the columns and spanning the floors with rigid-frame construction in which the beam members were haunched 18 WF 77's increased to a depth of 21 in. at the columns. The exterior columns of these frames were plated 18 WF 114's. The connection of beam to column was made with high-strength bolts. The increased cost of eliminating the interior columns was established by the steel fabricator to be approximately $70,000. The owners decided that the advantages of a column-free interior would be worth the additional cost.

The frames were connected to the columns by means of high-strength bolts to form a full moment connection. It was thought that these frames would add materially to the stiffness of the building, but a comparison of the stiffness of the frames with the stiffness of the wind trusses indicated that only 10 percent of the contributing wind shear could be carried by the rigid-frame panels before deflection of the frame nullified its action.

For this building, the architect was Edwin A. Keeble Associates; the structural engineer, Ross H. Bryan; the contractor, the J. A. Jones Construction Company; and the fabricator and erector of the structural steel, the Bethlehem Steel Company.

(This article was originally presented as a paper at the ASCE Knoxville Convention, before the Structural Division session presided over by Amour T. Granger, chairman of the Division's Session Programs Committee.)

Fuel system for Air Force base in Greenland constructed at top speed

Providing the life blood of Thule

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District Engineer, Eastern Ocean District, New York, N. Y.

From the start, the success of the Thule Air Force Base depended on oil products—fuel and lubricants. These were needed, first, for the planes which had to fly back to continental U.S. bases after delivering their vital cargo, and second, for the mobile equipment and for the generators that electrify the project. Thus oil products were the life-blood of the enterprise. Without these, the great base as it stands today could not have been built.

First major permanent construction job at Thule then was to erect tanks for the storage of various kinds of oil products. A storage capacity of approximately 2,000,000 barrels of these products was set by the USAF—making a large tank farm necessary. A distribution system had to be constructed and a temporary pipeline and pumping station installed as soon as possible so that the oil products could be unloaded promptly on arrival of the tankers. Because of the shortness of the open-water season, time was a critical factor.

Accordingly, in March 1951, North Atlantic Constructors, general contractors for the base, let a subcontract to the Chicago Bridge & Iron Company to provide the material and meet the time specifications for the required tank farm. The Thule job was given first priority. Within four days after agreeing to take the job, the company had placed purchase orders with six suppliers, and steel was rolling toward a fabricating plant at Greenville, Pa. Steel plates were rolled, cut to size, given proper curvature, and "pickled" in acid to remove the scale. The convex side of each sheet was given a shop coating of paint.

Careful planning and timing controlled the tanks from the shop to final erection. The loading of the steel was arranged for easy handling in tank units—four railway cars per complete tank. At Norfolk, a representative of the subcontractor supervised the unloading of cars and the loading of ships. An average of four complete tank units were loaded on each vessel, and there were enough vessels carrying tank elements to form a small fleet. Some of these vessels left the U. S. port with the first convoy to Thule and the remainder left with the second. They arrived in North Star Bay on July 15 and 25, 1951, respectively. An advance party of 6 supervisors and 15 men had been flown up in the latter part of June to assist in the unloading.

The contractor combed his many stateside jobs to get the most qualified men. Altogether, 189 men were selected. Proof of the qualifications of these men is reflected in the outstanding safety record they rolled up on the Thule job. They raised sheet steel for some 40 fuel tanks and completed 60,687 man-hours with only one lost-time accident, and even that one, a banged-up finger, kept the man off the job for one day only.

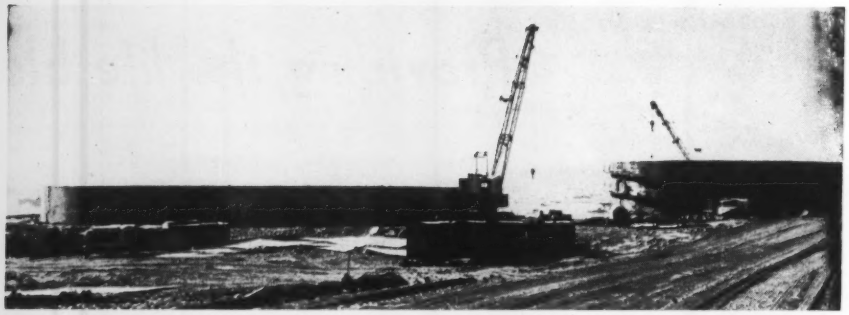
The men were divided into equal shifts for day and night operation. Each shift had 50 welders and 8 crane operators, plus additional steel men. The hand-picked men went to work as soon as the tank units were unloaded alongside the foundation pads which had been prepared by the general contractor to receive the tanks. These non-frost-susceptible pads were placed at all tank sites as well as at all building sites to avoid disturbing the permafrost level.

The pads were compacted and oiled to settle the dust, and tank erection started on July 22. The teams worked with a smoothness seldom exceeded in the construction industry. First, the base sheets were laid and welded. Cranes lifted the side plates as the tanks grew in height. The versatile workmen

Tanks appeared on Thule horizon at rate of one a day. Though dwarfed by arctic landscape, each tank has capacity of 55,000 bbl. Air base is at left. Astro Point, at extreme right, is tipped by DeLong dock.

were interchangeable and all worked against time, as the first tankers were scheduled to arrive the first week in August. As rapidly as a tank was completed, it was tested hydrostatically. Salt water from the bay was used for testing the first group of tanks on Astro Point. For tests on all other tanks, fresh water from local ponds was used.

Early in August the first tank was ready. Before the short arctic summer was over in mid-October the job was complete, and the majority of the tanks had been filled. More than 16,000 tons



Erection of tanks continued day and night, each shift having 50 welders and 8 crane operators. On completion tanks were tested hydrostatically with sea water.

Rubber tanks provide temporary storage on beach.

Navy frogmen plunge into icy arctic waters for construction of twin 10-in. steel pipelines leading to tanker mooring. Frogmen were used for demolition and preparation of pipeline site.

of steel had been placed. Within 42 days, forty 55,000-bbl tanks had been erected. Not a single day had been lost on account of weather.

While tanks were being constructed, provision was made for unloading the tankers. A suitable mooring was found, and three buoys were placed to provide one bow and two stern anchors at a depth of ten fathoms, some 3,000 ft off Astro Point, south of the DeLong prefabricated steel floating pier which was being installed at the same time the tanks were being built. Two pipelines, one for diesel fuel and one for Mogas and jet fuel, were constructed, each 2,884 ft long. Ten-inch steel pipe was laid under water, anchored and marked by buoys, with 135 ft of 10-in. flexible armored-rubber pipe, and at the sea end, an 8 in. × 10-in. reducer to accommodate the standard 8-in. discharge connection on the tankers. Another 125 ft of flexible pipe brought the line up the shore to a booster pumping station on Astro Point. Two of these lines were laid.

On account of the floating ice, the operation of laying, working, and anchoring the underwater connections was difficult. A floating 60-ton crane was employed at first, and later a Navy tug was used to hold up the sea ends of the pipes during actual pumping operations.

While crews were engaged in placing the submarine pipelines, other crews were extending 16-in. lines from the shore ends of the flexible pipes to the booster pumping station, and thence to the tanks on Astro Point. While these tanks were being filled, pipeline crews laid a temporary crossing across North Star River, and extended the 16-in. line through the rapidly mushrooming tank farm.

In spite of various difficulties caused by ice, high winds, irregular arrival of tankers, and minor leaks, the unloading of oil products continued until more than 1.4 million barrels of bulk fuels had been received. Using two pumps and two lines, an average of almost 6,000 bbl per 8-hour shift were handled during the 1951 construction season. All but a few of the tanks were loaded. During the process, more than 3,066,000 gal of water were pumped for testing.

After departure of the last tanker in 1951, work continued on the tank farm. Earth dikes were built around all tanks and stairways, and safety devices were installed on all tanks. The pipeline crews then turned to the completion of the buildings in the booster pumping-station.

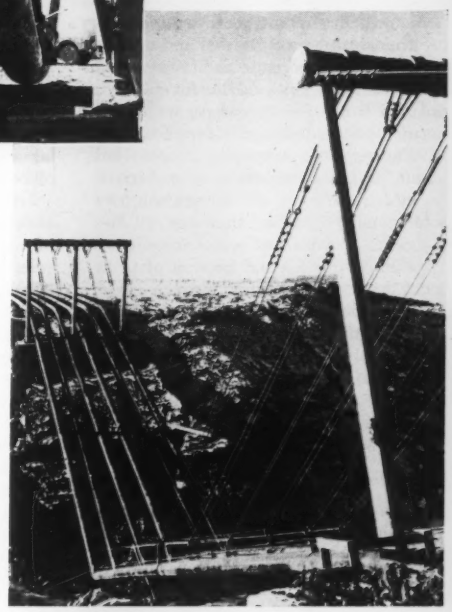
The system of unloading by submarine pipeline had been selected to avoid damage by floating ice, since the dock was not available for handling fuel during the shipping season of 1951. During 1952 and 1953, the tankers tied at the moorings and raised two marked buoys attached to the ends of the submarine pipelines. The tankers then made connections from their pumps to the lines that extended to the shore. The fuel passed through the booster pumping station and on to the storage tanks.

Tanks are filled in succession and this process continues as long as one product is being pumped. When a change-over is made from one product to another, corresponding valves are shifted in the tank farm, in the booster pumping stations, and at the shore connections. Enough salt water is injected into the pipeline used for the preceding product to insure filling the entire pipeline system from the intake to the last tank filled. The second product is then pumped by the tanker, flushing the salt water into the next tank to be filled. It is necessary to allow this salt water to settle, whereupon it can be drained from the bulk storage tank, using the drain valve provided.

The fuel distribution system, originally designed in 1951, and later extended, expanded, and modified in 1952 and 1953, was begun in August 1951 with the construction of a gravity-fed fill-stand for trucks on the beach south of the Astro Point tank farm. This original fill-stand met the needs of the contractor's forces during construction of the base.

Permanent distribution facilities consist of two transfer pumping stations located in the main tank farm. These stations distribute fuel to a pipeline network that crosses the river to the

Bend in 16-in. pipe is made at site by Trackson pipe layer.



Cables carry six lines across North Star River at one of two river pipeline crossings. Crossings are interconnected by two pipeline loops.

base area and thence runs to distribution points.

Both stations are located at low points in the main tank-farm area—one at the extreme west end and the other about midway between the east and west extremities of the area. Two river crossings are provided for the pipelines, one at the extreme west end of the farm, and the other in the neighborhood of the vehicle crossing of the North Star River (North Mountain Road). These pipeline crossings are interconnected through a loop which parallels North River on the north bank, and are further interconnected by a loop which completely encompasses the airfield and provides fuel for the hardstands.

Dispersing points are provided with fuel on demand in that the transfer pumps can be operated at any time to pressurize the pipelines so that fuel can be drawn off by any hardstand or fillstand operator. These extensive fuel distribution facilities are necessary because of the high speed required in modern aircraft refueling. Trucking operations would not be able to keep up with fueling needs in periods of emergency. Therefore a high-speed pressure system was installed at each hardstand.

Hydrant fueling facilities (high-speed) consist of storage tanks located at each hardstand plus a water separator building and an electrical control building with related piping and controls for dispensing the fuel to a hydrant outlet located in the center of each hardstand area. Similar facilities are provided at the operational apron for transient aircraft as well as at the fighter apron.

The buildings and tanks at each hardstand are arranged to take advantage of the topography and the arrangement of access roads. Defueling tanks are located at the nearest adequate low point.

Each hydrant fueling point is designed for operation by an attendant at the electrical control building or water separator building. Any hardstand fueling point can be operated by properly selecting the operating pumps in the electrical control building. There is a remote-control station at each fueling point, and the operator merely has to press a start button to pressurize the system from the pumps located on a nearby storage tank.

Facilities for defueling airplanes are operated merely by connecting a hose to the aircraft tank to be defueled and opening the drain valve on the aircraft. Fuel then flows by gravity to the defueling tanks.

Intercommunication and the application of ideas—

Surrounded as we are today by evidences of tremendous engineering achievements, many signs indicate that the recent past is only the beginning of an even greater engineering age. The volume of engineered work that will be forthcoming will probably surpass the wildest predictions of a few years ago. To support this volume of work with new methods and materials, much research and development will be needed.

Two dependent variables

The rate of our progress in the arts and sciences of our profession will be a function of two dependent variables: first, the efficiency with which information can be disseminated about basic research and the end products developed from it; and second, the speed with which useful development will flow from basic research.

It is in these two areas that I question whether we are proceeding as efficiently—and in as engineering-like a manner—as we should.

As to the first point, we often find that information we have needed and sought with much wasted time and effort eventually turns up—but too late for effective use and from a source where we would normally never think of looking for it.

Whether we are seeking information about design methods, new materials, or new techniques of fabrication, we soon come to realize that not all the relevant, or even the best information, appears on our normal horizon of technical literature. A great deal of information exists outside the usual channels of communication available to us—and particularly in the technical literature of engineering and scientific fields other than our own. It would be most valuable to have ready access to such information when needed.

Some unanswered questions

To point up the extent of the problem, I will mention a few questions that have occurred to me and led me to read technical literature outside the strictly civil engineering field.

For instance, with all the excellent research and development that has been carried out by members of the profession on riveted and welded plate girders, have we given proper consideration to the feasibility of glueing metal plates together with the new epoxy resin adhesives? There are known epoxy and other resins which have more than ample strength to bond steel to steel. Would this method be completely impracticable? Or don't we know? It may have some significant advantages.

Will we be able to utilize—in the field of hydraulics or concrete technology or elsewhere—the advantages of control over thixotropy that are claimed by certain manufacturers? Thixotropy, a new word to most of us, means the formation of a gel from a liquid by the use of vibration.

From France come reports of the development of glass fibers which show test strengths of two to three million pounds per square inch (psi). Can you think of any uses for this material?

Again from France come reports of wing spars of prestressed concrete produced by engineers for guided missiles. Such designs have proved capable of competing successfully with aluminum spars from the standpoints of weight, labor, and cost. Have we ever thought of concrete techniques in such a light?

Have you had deflection problems? How about a material with a modulus of elasticity of 90 million psi? And with compressive and tensile strengths of the order of 500,000 and 200,000 psi respectively? Do you know that such a material is commercially available? All designing engineers should.

These are just a few of the new materials and techniques that should be of interest to us as civil engineers. However, information on these things did not appear, to the best of my knowledge, in the literature usually read by civil engineers, or if it did, the presentation was such as to be ineffective in catching our attention. Instead this information appeared in technical publications normally considered as of interest only to

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are these being engineered?

aeronautical, automotive, chemical, electrical, mechanical or other engineering groups.

Accessibility of existing information

It seems that we are faced with a problem which concerns the availability or accessibility of existing information. To be sure, our own profession had done a splendid job of coordinating research and disseminating information about it within the bounds of our obvious and immediate interests. However, it appears that we are less than efficient in areas of intercommunication with other fields. Apparently it is only by accident that certain valuable information has been distributed effectively throughout all the engineering and scientific areas where it was needed.

I have discussed this problem of intercommunication with technical news reporters, and they acknowledge that it is a difficult one. They attempt to sort out the "important" from the "unimportant" in their published small blurb announcements of new developments in their special fields. Working from a tremendous mass of reports, manufacturers' information, and such, they probably do an excellent job as far as it goes. But it seems that the commercial necessity of specializing in areas of obvious reader interest interferes with the complete dissemination of information. Thus our time limitations as readers channel us into rather narrow reading habits. If what we read is too specialized, our view must be narrow—and we may not even be aware that it is.

This is an important problem that needs solving.

The second dependent variable—which is very much allied to the first—is this: Even where there has been adequate dissemination of information, it is amazing to note the length of time that elapses between the inception of a new idea and its first practical application. There seems to be a lack of motivation until necessity steps in and becomes the mother of invention. Then old ideas are rediscovered and put to valuable use.

As a case in point, fifty years or so passed between the first suggestions for prestressed concrete and the current practical application of this concept. In aeronautical engineering, the helicopter was discovered and used as a toy before 1900. It took another fifty years for its practical value to be recognized.

In most such cases, some individuals do see the light immediately. Usually it is only the force of their personalities or their willingness to make sacrifices, that serves to get the idea accepted by their confreres. As fascinating as such Horatio Alger-like success stories are, this is no way for engineers to deal with such situations. In view of our need for accelerated technological development, we must not accept such inefficiency.

Our profession has made wonderful achievement records, as attested by our present rate of progress. However, this progress seems often to be dependent upon accidental stumbling onto the right ideas when needed. Our profession has proved that it knows how to proceed from an idea to its use, when the use is in demand. But when the use is vague, we shelve the idea and rely on luck to produce it when needed at some future time. Does not this needlessly slow down our technological advancement?

What can we do about this?

I do not know the answer, though I do have some ideas that may contribute to the answer. The final solution must depend on expert advice in the fields of communication. The primary purpose of this article is to provoke discussion of the subject so as to ascertain the extent of the problem and perhaps to start work toward resolving it.

Functions of suggested committee

My ideas on the mode of solution may be summarized as follows. We should establish a committee served by and answering to all engineering and scientific societies, to act as a central agency. The functions of this committee would be to:

1. Receive, summarize, title, reference, and collate all new information from all technical sources aiming toward maximum availability. Special-interest groupings should be established, with cross referencing, on the basis that even a remote chance that a piece of information will be of interest should justify its classification in a field.
2. Distribute to those in the proper technical groups these items of information, on perhaps a monthly basis.
3. Maintain a board of experts for the critical analysis of new ideas with the mission of outlining possible inventions to make practical use of new ideas. These uses would be listed in their respective interest groupings and sent out in the same way as the new information in (2) above.

Now this would be a very tall order. Such a central clearing house would go far beyond the usual services of a technical library. Highly skilled technical personnel would be required for successful cross referencing. The magnitude of this part of the proposal alone will be recognized by technical news writers. Further, we would want the board of experts to be composed of engineers with a balanced awareness of modern theoretical and laboratory developments in all fields—as well as a background of practical experience. The board would work toward efficient initiation of inventions of practical use, built on the new basic concepts. An efficient schedule of observation, analysis, and then development would have to be followed through.

Would the value of such an up-to-date indexed compilation of practically all pertinent engineering information outweigh the costs of such an organization? What would the costs be? Today we have some marvelous machines of the IBM type which might do much of the collating labor automatically. Only the thinking would be left to the men.

Can we afford not to do something along these lines?

Volume common to two intersecting cylinders—general case

WILLIAM T. MOODY

Engineer, U. S. Bureau of Reclamation, Denver, Colo.

A solution to the problem of finding the volume common to two circular cylinders whose axes intersect at right angles was given by Norton B. Moore in the Engineers' Notebook section of CIVIL ENGINEERING for September 1933. More recently, in the February 1956 issue, B. Saelman resolved the same problem. These solutions are a special case of the more interesting general problem of determining the volume common to any two interesting circular cylinders.

In the general case, elements of the two cylinders intersect at an angle other than 90 deg, say β, and the axes are separated by a normal distance, say h. The solutions for this case are given below. Their development is lengthy and for that reason is omitted.

Following the notation used by Moore with R and r representing the radii of the large and small cylinders respectively, the problem divides itself into three catagories as $h + r$ is less than, equal to, or greater than R. These may be designated as complete, tangent, and partial intersections.

If we let $h = \eta R$ and $r = \rho R$ the volumes for the three cases are given below.

Case 1. Complete intersection, $h + r < R$, or, $\eta + \rho < 1$.

$$V = \frac{2R^3}{3 \sin \beta} \left\{ 6\eta(1 - \rho^2)KZ(\phi,k) + \sqrt{(1+\rho)^2 - \eta^2} \left[(2 + \eta^2 + 2\rho^2)E - \left(\frac{1+\eta-\rho}{1+\eta+\rho}\right)(2 + \eta^2 + 2\eta\rho - 2\rho^2)K \right] \right\}, \quad . \; . \; . \quad (1)$$

where

$$\phi = \sin^{-1} \sqrt{\frac{1-\eta+\rho}{2}},$$

$$k^2 = \frac{4\rho}{(1+\rho)^2 - \eta^2},$$

and

$$0 \leq \eta < 1, \; 0 \leq \rho < 1.$$

Case 2. Tangent intersection, $h + r = R$, or $\eta + \rho = 1$.

$$V = \frac{2R^3}{3 \sin \beta} \left[2\sqrt{\rho}(3 - 2\rho + 3\rho^2) - 3(1+\rho)(1-\rho)^2 \log_e \left(\frac{1 + 2\sqrt{\rho} + \rho}{1 - \rho} \right) \right], \quad . \; . \; . \quad (2)$$

where

$$0 \leq \rho < 1.$$

Case 3. Partial intersection, $h + r > R$, or $\eta + \rho > 1$.

$$V = \frac{2R^3}{3 \sin \beta} \left\{ 6\eta(1 - \rho^2)KZ(\phi,k) + \sqrt{\rho}[2(2 + \eta^2 + 2\rho^2)E - (1 + \eta - \rho)(2 + \eta + 3\eta\rho - 2\rho)K] \right\}, \quad . \; . \; . \quad (3)$$

where

$$\phi = \sin^{-1} \sqrt{\frac{2\rho}{1+\eta+\rho}},$$

$$k^2 = \frac{(1+\rho)^2 - \eta^2}{4\rho},$$

and

$$0 < \eta < 1 + \rho, \; 0 < \rho \leq 1.$$

In the above, $\log_e$ represents the natural logarithm to the base e; K and E are the complete elliptic integrals of the first and second kinds, modulus k; and $Z(\phi,k)$ represents Jacobi's zeta function of amplitude ϕ and modulus k which can also be expressed in terms of incomplete elliptic integrals as $KZ(\phi,k) = KE(\phi,k) - EF(\phi,k)$. Numerical evaluation is not difficult since all of the required functions are tabulated. (See, for instance, "A Short Table of Integrals," by B. O. Pierce, Ginn and Company, 1929, or "Handbook of Elliptic Integrals for Engineers and Physicists," by Byrd and Friedman, published by Springer, Berlin, 1954.)

It may be noted that the general restrictions on η and ρ exclude the point $\eta = 0$, $\rho = 1$, which in a sense is a common, limiting point for all three cases. It will be found, however, that all three relations give the correct volume at this point, provided l'Hospital's Rule is applied to evaluate the

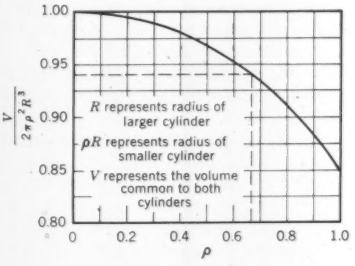

FIG. 1. Curve gives volume common to circular cylinders whose axes intersect at right angles. Dashed line indicates solution for Mr. Saelman's problem.

indeterminate form encountered in Eq. 2.

While Eq. 1, with $\eta = 0$ and $\beta = 90$ deg, does not immediately appear to be equivalent to the results of Moore and Saelman, application of Gauss' transformation for changing the modulus of elliptic integrals, converts one form directly to the other.

For this case where the axes intersect at right angles, since there is fundamentally only one independent variable, a single curve is adequate to give a complete solution. Accuracy obtainable by graphical representation, however, can frequently be improved by a judicious choice of parameters. In this case, if the dimensionless ratio $V/2\pi\rho^2R^3$ is selected as the dependent variable, results having a high degree of accuracy can be obtained. In Fig. 1, a curve with this parameter as ordinates is plotted against ρ as abscissas.

Two examples solved

Using the same example given by Mr. Saelman we have: $R = 30$ in., $r = 20$ in., hence $\rho = 2/3$. From Fig. 1 at $\rho = 2/3$, we read $V/2\pi\rho^2R^3 = 0.94$, from which

$$V = (0.94)\,(2\pi)\,(2/3)^2\,(30)^3$$
$$= 70{,}900 \text{ in.}^3$$

The actual volume, correct to five significant figures is 70,935 in.^{3}

As an example of application of the general case, consider the problem of determining the volume common to a horizontal tunnel and adit intersecting at an angle of 30 deg. Diameters of the two are 20 ft and 6 ft, respectively, and the center line of the adit is 3 ft vertically above that of the tunnel. Then $R = 10$ ft, $\eta = 0.3$, $\rho = 0.3$, $\beta = 30$ deg, and using Eq. 1, we have $\phi = 45$ deg, $k^2 = 3/4$, so that

$$V = \frac{(2)\,(10)^3}{(3)(1/2)}\left\{(1.8)(0.91)(0.539547) + \sqrt{1.6}\left[(2.27)(1.211056) - (0.625)(2.09)(2.156516)\right]\right\} = 1{,}064 \text{ ft}^3$$

Nomograph determines earthwork quantities

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Leo A. Daly & Associates, Architects and Engineers, Seattle, Wash.

Quantities of earthwork in cuts and fills are generally determined by the simple and well known method of "average end area." Using this method, the accompanying nomograph, Fig. 1, provides a quick and simplified solution without the need for unit conversion or the aid of a slide rule or calculator.

The average end area is found on the center linear scale by the application of a straightedge between points on the two outside scales, which represent values of the two end areas, ranging from zero to 1,000 sq yd. This value is used on the logarithmic scale to the left and a line is drawn to a point representing the value of L on the right-hand logarithmic scale. The quantity in cubic yards is read directly from the graduated scale labeled Q.

Example shows use

In the illustrated sample calculation, one end area, A_1, equals 160 sq ft; the other area A_2, equals 260 sq ft; and the length L, equals 20 ft. Place a straightedge on the nomograph, Fig. 1, connecting 160 on the outside left-hand scale (for A_1) with 260 on the outside right-hand scale (for A_2). Read 210 sq ft on the A_{avg} scale (middle right).

Now place one end of the straightedge on 210 on the A_{avg} scale (on the inside of the far-left scale), and the other end on 20, on the L scale (on the inside of the far-right scale). Read 155 cu yd on the Q scale (middle, left). This is the quantity desired.

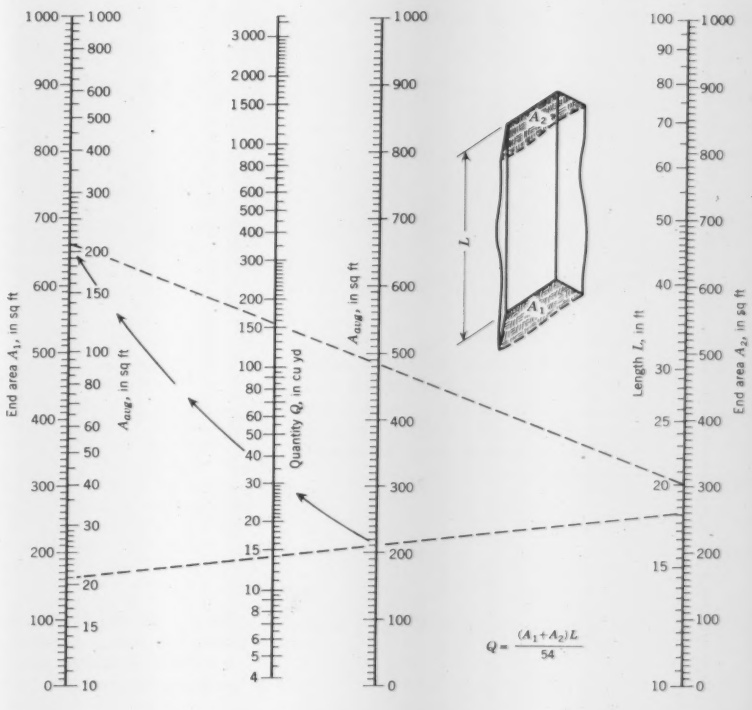
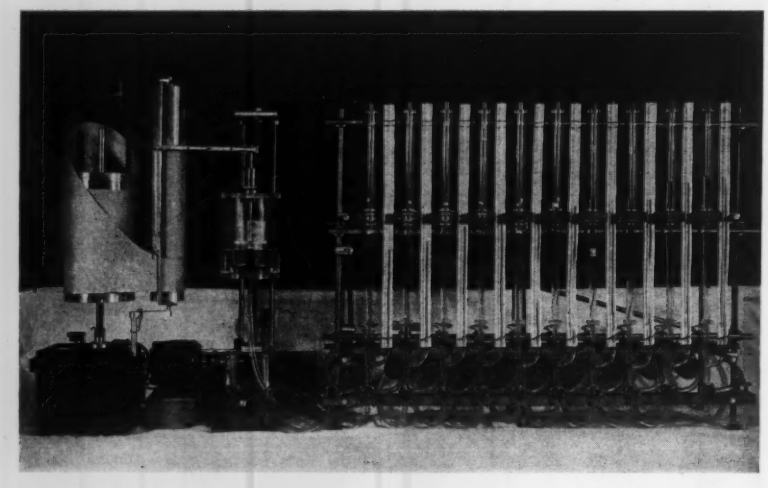


FIG. 1. Nomograph solves for earthwork quantities utilizing "average end-area method."

Hydraulic analog computer aids in solution of frost problems

HARL P. ALDRICH, JR., J.M. ASCE, Assistant Professor of Soil Mechanics, Department of Civil and Sanitary Engineering, Massachusetts Institute of Technology, Cambridge, Mass.

RONALD F. SCOTT, Soil Engineer, New England Division, Corps of Engineers, U.S. Army; formerly Research Assistant in Civil Engineering, Massachusetts Institute of Technology, Cambridge, Mass.



Main part of hydraulic analog computer is seen in photograph. Motor-driven paper templet, left, is cut to represent ground-surface temperature variations, which are converted to corresponding variations in water level by on-off servo motor.

A hydraulic analog computer, developed in the Civil and Sanitary Engineering Department at M.I.T. under the sponsorship of the Arctic Construction and Frost Effects Laboratory, New England Division, Corps of Engineers, is aiding in the solution of complex one-dimensional freezing and thawing problems in soil. These problems are assuming increasing importance in highway and airfield design, especially in arctic and subarctic regions.

It is generally recognized that three requirements must be met simultaneously for significant ice segregation and frost heave to occur in a foundation soil: (1) most obviously, below-freezing temperature must penetrate into the ground, (2) the soil must meet certain grain-size requirements to be "frost susceptible," and (3) a source of water

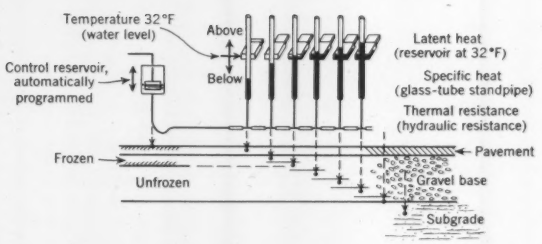


FIG. 1. Principles of operation of hydraulic analog computer are illustrated diagrammatically. When latent heat reservoirs are closed or eliminated, the computer can be used to solve complex one-dimensional consolidation problems in non-uniform soil.

must be available. The hydraulic analog computer involves the first requirement only, that of predicting subsurface soil temperatures under any given surface temperature condition.

The penetration of freezing temperatures in soil is basically a heat-flow problem which can be expressed mathematically by means of well established thermodynamic and physical laws. When these fundamental equations are applied to multi-layered soil systems, an analytical solution is not practically obtainable. However, a finite-difference approximation to the fundamental differential equations can be established and solved on the hydraulic analog computer.

The principle of operation of the hydraulic analog computer is illustrated in the diagram, Fig. 1. As heat is removed from a layer of soil, its temperature drops to the freezing point of soil moisture, normally 32 deg F. The temperature remains at this point until the latent heat of water is removed or, in other words, until the soil moisture freezes. After the layer is frozen its temperature drops below freezing. A soil profile may be divided into such layers, each layer being represented by a glass tube standpipe with an expansion reservoir. Water level in a standpipe corresponds to temperature for the soil layer it represents. Flow of heat within the soil is represented in the computing device by the flow of water. The characteristic of each standpipe and expansion reservoir, then, is analogous to the thermal energy versus temperature characteristic of the soil.

To represent resistance to heat flow between adjacent soil layers, a resistance to fluid flow between standpipes must be provided. In the hydraulic analog computer, laminar flow in the hydraulic resistance is maintained in openings of capillary size, which can be continuously varied in length.

Before an actual problem can be solved on the computer, the soil profile and its thermal properties must be known. Generally, the thermal conductivity, specific heat, and latent heat of each layer can be estimated from the water content and dry unit weight of the soil. The computer can then be set up with the appropriate standpipes, latent-heat reservoir openings, and hydraulic resistances. Ground surface temperature, represented by the water reservoir to the left in Fig. 1 and in the photograph, can be programmed automatically to follow actual or assumed variations in surface temperature with time by means of a moving paper template and servo motor system. A typical time scale is that for which one minute of computer operation corresponds to thermal variations for two days in nature.

The analog computer can handle such refinements as variation of specific heat and thermal conductivity with temperature. Furthermore, variations in the freezing temperature of soil moisture from layer to layer can be easily accounted for by raising or lowering the latent heat wells. In fact, almost any complex one-dimensional diffusion problem can be solved on the computer. Thus consolidation problems in soil engineering and diffusion problems in electrical engineering and other fields can be studied as well as heat transfer situations.

Principal advantages of the computer are simplicity of programming and operation, and provision for a continual visual check on the solution. While the number of units in the apparatus can be increased indefinitely to give more refined solutions, the accuracy of the present computer has been clearly demonstrated by solving problems with known analytic solutions.

During the coming year, research utilizing the computer will be directed toward further study of frost penetration in multi-layered soil systems. Heat transfer between air and pavement surfaces, which includes such factors as radiation exchange, convection-conduction, and evaporation, will be taken into account.

THE READERS WRITE

From parabola to bending-moment diagram for a beam

TO THE EDITOR: Referring to "A Short-Cut to Plotting Parabolas," by C. F. Ende in your June issue, it may be of interest that over 40 years ago, having to draw many parabolas in order to find plate cutoff lengths for steel beams, I discovered this shortcut and subsequently found it a time saver on many occasions. This graphical method was also extended to find a means of drawing the bending-moment diagram for a beam with a load increasing linearly from zero at one support to a maximum at the other.

In Fig. 1, set up BD at the center of the span, equal to $PI/12$; join AD and CD; drop a vertical at any point where the bending moment is required, say EF cutting DC at G. Project G to H on to the nearest support line; join H to D, cutting EF at J (which is a point on a parabola). Next project J to K on the right-hand support line; join K to A cutting EF at L. Make JM equal to EL, and M is then a point on the required bending-moment diagram. Similarly $BL_1 = DM_1$ and M_1 is a point on the curve.

The proof for the parabolic points has already been given, and the following proof is offered for the remainder of the construction.

The bending moment at any point, for a triangular total load of P, is:

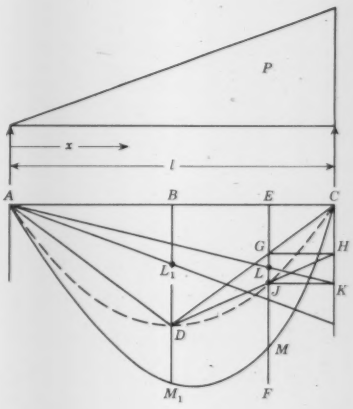


FIG. 1.

$$M_x = \frac{Px\,(l^2 - x^2)}{3\,l^2} \quad \ldots \quad (1)$$

The bending moment at any point for a total uniform load of P, is:

$$M_x = \frac{Px\,(l - x)}{2\,l} \quad \ldots \quad (2)$$

The bending moment at the center of the span for a triangular load is $(Pl)/8$, the same as for a uniformly distributed total load of P. Now Eq. 1 rewritten in terms of Eq. 2 is:

$$\frac{Px\,(l-x)}{2l}\,\frac{2}{3}\left(l+\frac{x}{l}\right) \quad . \quad . \quad . \quad (3)$$

so that the ordinates of a parabola constructed for a maximum bending moment of

$$\frac{2}{3}\times\frac{Pl}{8}=\frac{Pl}{12}$$

at the center. Increased by x/l, these will be the ordinates of a bending-moment diagram for a beam with a triangularly increasing load from the x origin.

A. J. Ashdown
Structural Engineer

Bexleyheath, Kent
England

Plotting parabolas by short-cut method

To the Editor: Congratulations to C. F. Ende on the independent discovery of the short-cut method of plotting parabolas (June issue, p. 67) and thanks to Prof. D. Ryan for the analytical proof of the graphical procedure. The construction has been known for at least thirty years to numerous students of Prof. K. Bartel, who was the Professor of Descriptive Geometry at the Technical University of Lwów, Poland. However the proof of the construction was derived by him on the principles of projective geometry, in particular with the aid of the so-called "Pascal's straight line." The latter is used to find a sixth point on a conical curve, which in general is defined by five given points. Line *EG* (Fig. 1 of Mr. Ende's article) was proved to be the "Pascal."

The construction is really excellent; for speed, neatness, and economy of lines on the drawing, it is superior to any other known method. It is applicable to any part of a parabola for which we know: (1) one point and the direction of the tangent at that point, (2) the direction of the axis, and (3) another point.

These data determine the location of five points on the parabola: (1) above is equivalent to two points, Points 1 and 2; (2) above also represents two points, as any line drawn parallel to the axis passes through a definite "point" (Points 4 and 5), in infinity, on the parabola; so together with another point (Point 3) we have five points on the parabola. The proof, based on the principles of projective geometry, is obvious from Fig. 1.

In more detail it is as follows:

It is required to find a point (Point 6), on the parabola, located on any line, parallel to the axis of the parabola.

Principle. Any two lines connecting four of six different points of the parabola do intersect on one straight line, the "Pascal."

Procedure. The selected line passes through Points 5 (∞) and the unknown Point 6; its intersection with Line 13 determines one point (I) of the "Pascal." The intersection of Lines 12 and 45 which determines the second (II) point of the "Pascal" lies in infinity in the direction parallel to Line 12, that is, the given tangent. The "Pascal" therefore passes through Point I and is parallel to the given tangent. Line 35 is parallel to the axis. It intersects the "Pascal" in Point III. Therefore Line 16 is identical with Line 1, III. This together with Line 56 determines the location of Point 6.

The special advantage of this method lies in the fact that only the full-drawn lines need be drawn, thus keeping the drawing clear and neat. All the points need to be marked only as light pencil marks. There is no need for any computations, or the use of a scale. Moreover it is easily seen that the method is also applicable to extrapolation of points beyond the given points. Its application to the graphical determination of envelopes of maximum bending moments for systems of moving concentrated loads simplifies that work enormously. Also for plotting the diagrams of bending moments in continuous structures for uniformly distributed loads, and for plotting of maximum shear diagrams for uniformly distributed live loads, the method is very useful indeed.

S. J. Mazur
Assoc. Prof. of Civil Eng.
Nova Scotia Tech. College

Halifax, N.S.

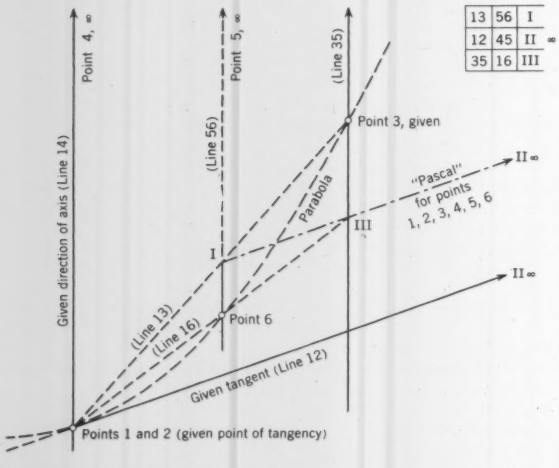


FIG. 1.

Marine platform built to withstand hurricane winds

To the Editor: In connection with my article, "Prestressed Precast Platform Built in Gulf," in the July issue, p. 41, it may be of interest to state that the structure was designed for a hurricane wind load of 62.5 lb per sq ft and a breaking wave +36 ft high. The surge in the tanks was taken as 5 percent of the weight of the oil in the tanks.

Robert N. Bruce, Jr., M. ASCE
Engineer, Raymond Concrete Pile Co.

New York, N.Y.

Wrong researcher named

To the Editor: I regret very much that the text of my article, "Welded-Stud Shear Connectors for South Dakota Bridge," in the June issue, carried the name of Prof. C. P. Siess, M. ASCE, instead of that of I. M. Viest, J.M. ASCE, Research Associate Professor of Theoretical and Applied Mechanics at the University of Illinois, as being responsible for the investigation to which I referred in connection with welded stud shear connectors, on page 40.

I have followed with great interest the tests and investigations conducted both separately and jointly by Doctors Siess and Viest since 1952. Because of the close association of these two researchers, I very carelessly dictated the name of Doctor Siess instead of that of Doctor Viest in referring to the specific investigation concerning the welded studs.

I extend my apologies both to the Society and to the Doctors Viest and Siess.

K. R. Scurr, M. ASCE
Bridge Engineer, South Dakota Dept. of Highways

Pierre, S. Dak.

AMERICAN SOCIETY OF CIVIL ENGINEERS

Irrigation and Drainage Division Conference

Davenport Hotel **Spokane, Wash.** **Sept. 6–8, 1956**

Sponsored by the Irrigation and Drainage Division and the Spokane Section

REGISTRATION

Davenport Hotel
Each day of the conference

First Session

THURSDAY MORNING

SEPT. 6

Panel Discussion on Consumptive Uses of Water

Presiding: George N. Carter, M. ASCE, Chairman, Executive Committee, Irrigation and Drainage Division; Regional Supervisor of Irrigation Operations, Region 1, U. S. Bureau of Reclamation, Boise, Idaho.

Moderator: George D. Clyde, M. ASCE, Commissioner of Interstate Streams for Utah.

Agricultural Uses

WAYNE D. CRIDDLE, Irrigation Engineer, Agricultural Research Service, U. S. Dept. of Agriculture, Logan, Utah.

Municipal Uses

KENNETH Q. VOLK, M. ASCE, Consulting Engineer, Los Angeles, Calif.

Industrial Uses

RAY L. DERBY, M. ASCE, Principal Sanitary Engineer, Dept. of Water and Power, Los Angeles, Calif.

Second Session

THURSDAY AFTERNOON

SEPT. 6

Presiding: Howard T. Critchlow, M. ASCE, Member, Executive Committee, Irrigation and Drainage Division.

Drainage Problems on the Columbia Basin Project

Part 1. The Irrigated Areas

GEORGE E. NEFF, Head, Drainage Section, Irrigation Division, Columbia Basin Proj., U. S. Bureau of Reclamation.

Part 2. The Soap Lake Basin

KEITH E. ANDERSON, Regional Drainage Engineer, Region 1, U. S. Bureau of Reclamation, Boise, Idaho.

Recent Developments in Lower-Cost Canal Linings

RICHARD J. WILLSON, Engineer, U. S. Bureau of Reclamation, Denver, Colo.

Canal Seepage Studies for Evaluating the Effectiveness and Need of Canal Linings

C. C. WARNICK, J.M. ASCE, Assoc. Research Professor, University of Idaho.

Third Session

FRIDAY MORNING

SEPT. 7

Presiding: Hjalmar T. Person, Member, Executive Committee, Irrigation and Drainage Division; Dean of Engineering, Univ. of Wyoming

Drainage Investigation of a Pumped Artesian Well Adjacent to a River

VERNE H. SCOTT, J.M. ASCE, Asst. Professor of Irrigation, Univ. of California; and J. N. LUTHIN, Dept. of Irrigation, Univ. of California.

Economics and Limitations of Monolithic Concrete Pipe for Distribution Systems

LOUIS H. KRISTOF, M. ASCE, Valley Concrete Pipe and Products Co., Yuba City, Calif.

Corrosion Studies for Buried Pipe Systems

MARK F. ADAMS, Head, Chemistry Section, Washington State Inst. of Technology, Pullman, Wash.

Fourth Session

FRIDAY AFTERNOON

SEPT. 7

Presiding: Harry F. Blaney, Chairman-Elect, Executive Committee, Irrigation and Drainage Division; Principal Irrigation Engr., Agricultural Research Service, U.S. Dept. of Agriculture, Los Angeles, Calif.

Quality of Water

CHARLES S. HOWARD, Aff. ASCE, U. S. Geological Survey, Menlo Park, Calif.

Relationship of Irrigation and Drainage to Public Health

LLOYD E. MYERS, JR., Irrigation Engr., Agricultural Experiment Sta., Reno, Nev.

Recent Advances in Reservoir Evaporation Control

RUSSELL G. DRESSLER, Southwest Research Inst., San Antonio, Tex.

CONFERENCE EVENTS INCLUDE

Sept. 6, Men's Luncheon

Sept. 6, Women's Luncheon (Crescent Dept. Store)

Sept. 7, Women's Luncheon (Country Club)

Sept. 7, Dinner

Sept. 8, Field Trip

HOUSING ACCOMMODATIONS

The headquarters for the Conference will be the Davenport Hotel, Sprague at Post Street, Spokane, Wash. Request for reservations should be sent directly to the hotel, mentioning attendance at the Conference.

Numerous additional facilities, either hotel or motel, are available in and about Spokane. Should additional information be desired, forward request to:

MR. CHARLES I. HAZEN
W. 1323 Ide Ave.
Spokane, Wash.

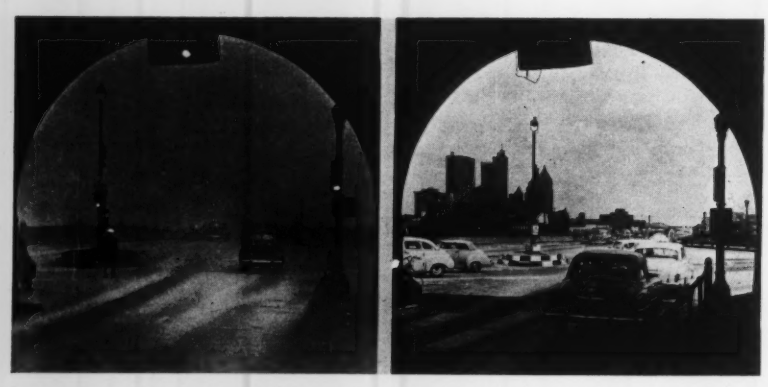
SOCIETY NEWS

Pittsburgh Extends Hearty Welcome to ASCE Convention

Visitors to Pittsburgh, Pa., for ASCE's Annual Convention the middle of October, will find a city that has carried through a large-scale redevelopment program and is still planning and executing major facilities to contribute to the city's "new look." This "new look" is evident not only in the famous Golden Triangle, but in numerous cultural, recreational, educational, research, and industrial developments of note throughout the area.

The city's leadership in industrial research is being maintained in many ways. New research centers have been built or are under construction by Allegheny Ludlum Steel Corp., the Koppers Company, the H. J. Heinz Co., Pittsburgh Plate Glass Co., the Dravo Corporation, Mine Safety Appliance Co., Jones and Laughlin Steel Corp., U.S. Steel Corp., Westinghouse Electric, and Robertshaw-Fulton Controls Co. Others that have added substantially to existing centers include the Aluminum Co. of America and Gulf Oil Corp.

Pittsburgh's Oakland Civic Center is dominated by the 42-story Cathedral of Learning of University of Pittsburgh. Campus of Carnegie Institute of Technology is in the right background.



Looking through the Liberty Tubes toward downtown Pittsburgh, these "before" and "after" photos show striking progress Pittsburgh and Allegheny County have achieved in air-pollution control.

Engineers are familiar with Pittsburgh's historic and highly successful struggle against smoke and smog. Between 1946 and 1955, hours of heavy smoke were reduced by 96.6 percent in the city, and total smoke declined by 88.8 percent. Intelligent laws and their enforcement, strong civic support, and intensive research have been the keys to success in this notable achievement.

As for stream pollution, the Sanitary Authority of Allegheny County is attacking this problem by undertaking a gigantic sanitary sewer and treatment plant project. With the negotiation of a 100-million-dollar loan by the Authority, construction has already begun. This system is designed to open Pittsburgh's rivers for recreation and to permit the gradual restoration of fish life.

Pittsburgh's energy and ambition have also been brought to bear in the field of education. At least 100 million dollars has been recently or is being now spent on development programs at Carnegie Institute of Technology, Duquesne University, the University of Pittsburgh, Chatham College, and Mt. Mercy College. These programs include Carnegie Tech's 50-acre Nuclear Research Center, begun in 1948, at Saxonburg, Pa., which has since become one of the best in any educational institution in the country, and, at the University of Pittsburgh, a Health Center program that will give the university a position of eminence in this field.

In culture and recreation, also, the Steel City does not intend to be left behind. Its cultural attainments have long been outstanding. Among other institutions ranking with the nation's best it can boast the Allegheny Observatory, Buhl Planetarium and Institute of Popular Science; Carnegie Institute including a museum, library, art galleries and a music hall; and

Phipps Conservatory, where splendid spring and fall flower shows are held. Other cultural features of which the city has cause to be proud are the Stephen Foster Memorial, Pittsburgh Playhouse, Pittsburgh Symphony, Pittsburgh Opera, Highland Park Zoo and the Children's Zoo.

"Pittsburgh is a city of energetic striving and substantial accomplishment. The enthusiastic partnership of private citizens and government officials has made it a united community ardently concerned with completing the giant tasks of today." So states John J. Grove, Assistant Director of the Allegeny Conference on Community Development, in extending one more of the hearty welcomes to the Society that have come from all directions in the "Steel City."

Secretary Wisely Visits Latin-American Sections

Active interest in the Society and its affairs is the rule in the Local Sections south of the Border. Executive Secretary W. H. Wisely has just returned from a liaison tour of the Panama, Venezuelan, and Puerto Rico Sections. In all three Sections he found many opportunities to discuss Society and Section operation on both a formal and informal basis. Everywhere he encountered the kind of hospitality we have come to associate with Latin-American countries.

A full four-day schedule in the Canal Zone began for Mr. Wisely when he arrived at Tocumen Airport, Panama, for a visit to the Panama Section, June 21–24. Accompanied by Mrs. Wisely and his daughter, Mr. Wisely was met by Celso A. Carbonell, first vice-president of the Panama Section and president of the Panama Society of Engineers and Architects; Nelson E. Wise, past-president of the Section; and Joseph M. Cooke, member of the Program Committee.

Mr. Wisely was guest speaker at the Thursday noon meeting of the Panama Rotary Club. He was introduced by Col. Hugh M. Arnold, president of the Panama Section. A launch trip through the Panama Canal from Pedro Miguel locks, through the famous Gaillard Cut, to Gamboa, and then a tour of the Miraflores locks gave Mr. Wisely a first-hand view of the Canal and its operation. On Thursday evening, the Wiselys were guests of Mr. and Mrs. Joseph M. Cooke for cocktails and also attended a reception for Maj. Gen. William E. Potter, new Governor of the Canal Zone, at the Tivoli Guest House in Ancon. In addition to small, informal gatherings with Panama Section officers, on Friday evening Mr. and Mrs. Wisely and their daughter were guests of honor at a dinner meeting of the Section at the Tivoli Guest House. On Saturday night they were honored at a reception given by the Panama Society of Engineers and Architects at the Panama Golf Club in Panama.

Mr. Wisely finished his visit with a Saturday tour to the Atlantic side of the Isthmus, visiting Madden Dam and Fort San Lorenzo. He departed Sunday afternoon to Venezuela for a visit to the Section there.

An important feature of the trip to Caracas, June 25–28, was a visit to the Ciudad Universitaria and a conference with Eduardo Arnal, dean of the college of engineering, and other engineers on the faculty concerning the possible formation of an ASCE Student Chapter there. Mr. Wisely lunched with Venezuelan Section officers on Monday and conferred with them again on Wednesday, preceding a Section dinner meeting at the Hotel Tamanaco. There was a turnout of 75 percent of the Section membership for the dinner, at which local problems in sanitation were discussed.

High points of the trip to Venezuela included a visit to the Mariposa Treatment Plant and an extension to it now under construction, and inspection of the new Tuy River Intake pipeline with its four booster pumping stations in series. Mr. Wisely also visited the Cooperative Inter-American Office on Public Health. Section President E. J. Aguerrevere and Secretary Santos Michelena were indefatigable hosts.

As a guest of the Puerto Rico Section from June 28 through July 3, Mr. Wisely was the principal speaker at a formal dinner meeting on Saturday evening, June 30. His talk covered current Society activities, including international aspects of its interests. On Monday, July 1, he addressed a gathering of 80 engineers of the Puerto Rico Aqueduct and Sewer Authority on water pollution control practices in the United States and Europe. The "Aqueduct Day" program was arranged by R. J. Auld, director of safety for the Aqueduct and Sewer Authority.

In addition to these formal events, Mr. Wisely had an opportunity to discuss Society and Section affairs with the officers and directors at several informal get-togethers. One of the most delightful of these was an all-day beach party and picnic, at which a succulent roast pig was the *pièce de résistance*. An airplane trip over the island was enjoyed through the courtesy of Dr. Miguel Quinones, director of the Water Resources Authority of Puerto Rico.

The Wiselys' hosts for the unforgettable schedule of activities included Section President Jorge J. Jimenez; Vice-President Stanley Kadala; H. A. Deliz, secretary-treasurer; F. Lizardi; and Past-President W. C. Hill.

During their visit to the Panama Section Wiselys are entertained by Mr. and Mrs. Joseph M. Cooke. View shows (in usual order) Section President and Mrs. Hugh M. Arnold; Mrs. Wisely; Celso A. Carbonell, vice-president of Section and president of Panama Society of Engineers and Architects; Mr. Wisely; Mrs. Carbonell; and the Cookes.

Board of Direction Approves New York for E.S. Center

At a meeting in New York on July 10, the Board of Direction concurred in the recommendations of the Special Task Committee of Fifteen on the Engineering Societies Center (July issue, page 74). In the main, these recommendations were that the Center remain in New York City, and that United Engineering Trustees work out the details of the project.

The task committee, which submitted its recommendations to the governing boards of the societies concerned, consisted of three representatives each of the four Founder Societies and the American Institute of Chemical Engineers. The Boards of AIME and ASME also have concurred in the recommendations of the Committee of Fifteen.

Tellers Canvass Ballot for 1957 Officers

To the Secretary
American Society of Civil Engineers:

July 2, 1956

The Tellers appointed to count the Ballot for Official Nominees report as follows:

For Vice-President—Zone II
(Term October 1956–October 1958)

Francis S. Friel	1,202
Scattering	275
*Ineligible Candidate	15
Void	1
Blank	8
Total	1,501

For Vice-President—Zone III
(Term October 1956–October 1958)

Norman R. Moore	1,592
Scattering	338
*Ineligible Candidate	51
Void	1
Blank	19
Total	2,001

For Director—District 1
(Term October 1956–October 1959)

Clinton D. Hanover, Jr.	169
Scattering	171
*Ineligible Candidate	111
Void	0
Blank	14
Total	465

For Director—District 4
(Term October 1956–October 1959)

E. Leland Durkee	145
Scattering	71
*Ineligible Candidate	34
Void	0
Blank	9
Total	259

For Director—District 8
(Term October 1956–October 1959)

Howard F. Peckworth	302
Scattering	28
*Ineligible Candidate	32
Void	1
Blank	10
Total	373

For Director—District 11
(Term October 1956–October 1959)

Finley B. Laverty	1,259
Scattering	127
*Ineligible Candidate	53
Void	3
Blank	9
Total	1,451

For Director—District 14
(Term October 1956–October 1959)

William J. Hedley	379
Scattering	19
*Ineligible Candidate	10
Void	1
Blank	13
Total	422

For Director—District 15
(Term October 1956–October 1959)

Randle B. Alexander	397
Scattering	99
*Ineligible Candidate	75
Void	0
Blank	8
Total	579

* These votes were cast for incumbent officers who are presently ineligible for reelection in accordance with Section 9, Article VI of the Constitution.

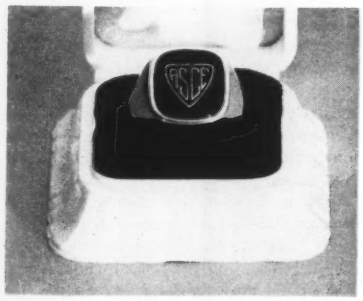
Total number of ballots counted	7,051
Ballot envelopes without signature	13

Respectfully submitted,
THOMAS J. WICKMAN
Chairman
AUSTIN E. BRANT, JR.
Vice-Chairman

Egidio O. Di Genova
Irwin S. Toporoff
Anthony S. Caserta
George A. Burpee
Fred Caiola
Seymour Gerstein
Anthony N. Mavroudis
Giles G. Green
Walter E. O'Leary
Edgar H. Hendler
(*Tellers*)

Society Ring Proposed

In response to requests for an ASCE ring to complement the line of Society jewelry, ASCE has had the ring pictured here made up on a sample basis. The ring



is a 10-k gold signet, with the face in black obsidian and ASCE lettered in gold on it. Attention is called to the fact that the ring carries the same insignia as the Society's lapel button.

If 200 firm orders are received, the ring will be made available. The price will be $27.50, including tax. Do not send money at this time.

ASCE MEMBERSHIP AS OF JULY 9, 1956

Members	9,258
Associate Members	12,049
Junior Members	17,843
Affiliates	72
Honorary Members	41
Total	39,263
(July 9, 1956	38,622)

Mind Your Language

CHARLES M. BAYER, Public Relations Consultant to ASCE, New York, N.Y.

These are the comments of a person who, as a newspaper man, often wished that engineers—and other professional men—could express themselves clearly and effectively to laymen and who, as the associate now of some of them, has been trying to help them do so.

Public relations is an effort to earn the appreciation of folks and to develop and maintain that appreciation. It is an *activity*. We cannot sit on the porch and wait for public relations to come along and hand itself over. We have to *strive* for it.

Public relations is not new, though two aspects of it are new. One is the relatively recent public awareness of the field, the other is the fast-increasing resort to it. In today's exceedingly competitive world, public relations is a major instrument of successful competition. Realization of this fact has impelled innumerable industries to budget large sums in the public relations field and, in many instances, to raise their public relations directors to vice-presidencies and to participation in determination of policy. Public relations has become virtually an indispensable function of management of universities, baseball, clubs, grocery chains.

I have heard such questions as, "Why can't engineers get publicity the way the doctors do, or the bankers, or the manufacturers?"

Some of the professions have been notably successful in this respect—the American Bar Association, the American Bankers Association, and the American Medical Association. Their efforts have been effective because these are unity organizations, and as such, they have public relations departments and professional public relations direction to see to it that their papers and presentations to the public are in the public's language. As unity organizations, taking in all branches of their respective professions, they do an all-embracing effective public relations job. There are exceptions. Sometimes doctors and scientists and lawyers still talk to the public in gobbledygook. In an article in a recent issue of the *Saturday Evening Post*, a doctor implores other doctors, when explaining the ailments under treatment, to talk to their patients in the patients' language, not the doctors'.

Engineering is not yet organized completely. One day, undoubtedly, it will be. When that happens, engineering, too, can establish a thoroughgoing, all-embracing program of public relations for the profession as a whole. Meanwhile, each engineering society still can do, and in some instances is doing, its own public relations job. The unity program is in the future. In the present, what can we do, as societies, or groups of societies? Why do we want public relations programs?

Engineers want public relations for the same reasons lawyers and bankers and doctors and manufacturers want it. We want public favor. We want it particularly in these highly competitive days when we are trying to induce students to think of engineering as a career. We want it in these days when we are hopeful that parents will appreciate engineering and pass that appreciation on to their student sons. We need it so that we may enroll more members. And we need it because the prestige reflected in public appreciation is one of the important rewards of dedication to a profession.

Activity is a key word. Some people think of public relations as a magician's trick of pulling rabbits out of a hat. Others regard it as a piece of skulduggery, a clever hiding of facts, covering up of truths. On the contrary, the job of public relations is to expose facts and truths to the public eye so that the public's understanding and approval may be courted and gained.

Understanding is another key word. In a recent article on public relations, *Fortune Magazine* said, "Public relations will grow still bigger. Top management will see to that. . . .Good public relations is good performance publicly appreciated because adequately communicated."

Before the recent ASCE Convention in Knoxville, a local newspaper man said to a member of the Tennessee Valley Section's Publicity Committee that he was greatly disturbed over whether civil engineers could tell their convention story to the reading public in the reading public's language.

The summaries of convention papers, prepared in advance of the meeting, were written in the language of the general public. Such convention papers as were so complicated and technological as to forbid translation into the newspaper readers' language were not summarized for the press. The summaries that were prepared enabled the Knoxville press to give extraordinarily generous space to the proceedings.

That generous space, however, should not have been regarded as extraordinary, for the subjects of the convention were, in many instances, of major and everyday importance to all persons and thus justified press interest. What was extraordinary was that it seemed natural that the press felt the civil engineers might not be able to tell their story to the public in language the public would understand.

Perhaps that apprehension was justified, for engineers, as a rule, talk and write to engineers and, therefore, talk and write like engineers. So, too, at times, do lawyers and doctors and scientists. In general, each category thinks in its own language and addresses itself to itself. This tone of intramural language must be guarded against in whatever efforts are made to communicate engineering's purposes and achievements to the general public.

It is pertinent to quote from President Needles' convention address:

"As a part of doing his job right, the civil engineer should have reasonable facility and skill in the art of communication with the public, his fellowman.

"Where else can your civil engineer student begin to improve himself in the art of expression better than during his college days? Any curriculum which does not recognize adequately the importance of this tool of the practicing civil engineer is an example of a lost opportunity for very beneficial instruction."

The *New York Times* of June 14, 1956, said:

"A builder of many notable public works advised a group of budding engineers yesterday to learn to 'read and write simple Anglo-Saxon.' The suggestion came from Robert Moses, city construction coordinator and chairman of the Triborough Bridge and Tunnel Authority, in a commencement address at Polytechnic Institute of Brooklyn.

"Engineers are notoriously bad writers," Mr. Moses asserted. "It is precisely because so much of their professional life is concerned with subjects other than engineering that I urge them to rise above the jargon of the trade to what Stevenson—the Samoan, not the egghead—called a consideration of the art of life."

Most important of all, when preparing a release, have it earnestly in mind that the first member of the public who will read and try to understand the release will be the newspaperman. If the newspaperman doesn't understand your release, the public won't. For the newspaperman won't even pass it on to the public.

If the subject of your release is too technological for a layman's understanding, forget it. Toss it away—before the editor does. There'll be another day, with a subject that can be translated into the public's talk.

Engineers, as a whole profession, and engineers in their respective branches of the profession, have a great story to impart to the public—a public which takes for granted the multitudinous developments that have made civilization possible, that have made possible everyday

living. The public takes all these astounding accomplishments for granted without often enough realizing the intellect and drama and striving that go into them, because engineering has not yet, except in the case of some individual societies, undertaken the necessary and fascinating job of telling the public.

In an address on public relations before the National Coal Association, Thomas J. Ross, senior partner in the eminent public relations firm of Ivy Lee and T. J. Ross, made this observation:

"Public relations may be considered by some as something that anybody can do if you just pin the right label on him and tell him he is it and go about your business, serene in the notion that your public relations are all fixed."

Well, you just don't accomplish good public relations that way.

The ideal arrangement, of course, is to have the advice of a professional public relations man. But if you can't afford a full-time professional public relations employee or consultant, don't feel at all defeated. We have, in our Society and in each local area, a great public story to tell the public.

Of the many channels of adequate communication most commonly used—and often the most useful—are the press and the air waves. Put on your hat and go around and visit with these people and talk things over with them, or have a staff member do so, even though you aren't a trained public relations practitioner and aren't able to engage one. Very likely, you'll find them receptive and surprised that you have so much of interest to offer.

Polysyllables scare people. And when the polysyllables are technological, people start looking at wrist watches and mumble about other engagements. Short, simple words are very attractive. A monosyllable can say a lot. When you're talking or writing to the public, mind your language!

ASCE Task Force Studies Reservoir Sediment Distribution

The Hydaulics Division's recently organized Task Force on Reservoir Sediment Distribution held its first meeting in Champaign, Ill., in May. The three-day session was welcomed by William C. Ackermann, chief of the Illinois State Water Survey Division, which was host to the group. W. M. Lansford, member of the executive committee of the Hydraulics Division and of the University of Illinois faculty, also greeted the group. H. E. Hudson, Jr., chairman of the ASCE Task Force on Reservoir Sedimentation, was present to help coordinate the activities of the two Task Forces to avoid duplication of programs.

With surveys and records available from various agencies, the new Task Force will try to provide a technique for predicting, as quantitatively as data permit, the distribution of reservoir deposits. Both vertical distribution along the reservoir profile and horizontal or plan distribution will be investigated. The study will also attempt to encompass the effects of particle size of sediment, reservoir operation, manner and location of sediment entrance, density flow, and quantity of water.

Small reservoirs will be treated separately by a working party by J. B. Stall, associate engineer of the Illinois State Water Survey Division. Carl R. Miller, hydraulic engineer for the Bureau of Reclamation, will be group chairman of the study on large reservoirs. Samuel Shulits, director of the Hydraulics Laboratory at Pennsylvania State University, is chairman of the Task Force.

As guests of J. B. Stall, members of Task Force inspect sediment deposits exposed at headquarters of Lake Bloomington, water supply source for Bloomington, Ill. Shown here are Floyd Fowler, Mr. Stall, and Chairman Samuel Shulits.

Engineering Mechanics Division Plans Special Program

Recent developments in solid-state physics are beginning to have a real influence on the understanding and development of engineering materials. For this reason the Engineering Mechanics Division has scheduled its first symposium on the Physics of Engineering Materials for the forthcoming Pittsburgh Convention. There will be two sessions, both to be held on Monday, October 15, one in the morning and the other in the afternoon.

At the first session, on Monday morning, Dr. Frederick Seitz, Professor of Physics at the University of Illinois, will open the program with his paper on "Influence of Imperfections in Crystals." Many of the properties of crystalline solids are determined in a critical way by the imperfections present; this conclusion has been reached as a result of several years of research. Professor Seitz will correlate various types of imperfections with their effects on the properties of materials and will discuss some examples of the effects arising from the interaction of different types of imperfections.

Several effects of dislocations on the mechanical properties of materials will be presented by Thornton Read, of the Bell Telephone Laboratories, Murray Hill, N.J., in his paper entitled "Dislocations." Of special importance to civil engineers will be his explanation of the influence of dislocations on properties associated with plastic deformation and the work hardening of crystalline materials.

"Internal Friction of Metals" is the subject to be presented by Dr. Clarence Zener, acting director of the Westinghouse Research Laboratories. He will define internal friction as the capacity of the metal to dissipate mechanical energy of vibration, and will relate the property of a metal which gives rise to internal friction to other mechanical properties such as stress relaxation and recoverable creep. Dr. Zener will discuss some pioneering work just announced on the design of a new alloy, Nivco. This is the first of a series of alloys into which a high internal friction will be designed for particular uses.

At the second session, on Monday afternoon, the "Effect of Radiation on Material Properties" will be discussed by Dr. G. J. Dienes, of Brookhaven National Laboratory, Upton, N.Y. He will describe the types of defects introduced into materials by the interaction of high-energy radiation with matter, and will discuss the more important defects which lead to changes in the physical properties of structural engineering materials. He will present some suggestions for minimizing the effects of radiation on the properties of materials.

"Materials for Reactor Shielding" will be the last paper in the symposium, to be co-authored by Dr. A. M. Weinberg, Director of Oak Ridge National Laboratory, and E. P. Blizard, Director of the Applied Nuclear Physics Division of the same laboratory. This paper will deal with the fundamentals leading to the choice of reactor materials for shielding against penetrating radiations which constitute significant biological hazards.

A summarizing discussion of the five papers in the symposium will terminate the second session. This discussion will be presented by Dr. Glenn Murphy, Professor and Head of the Department of Theoretical and Applied Mechanics, Iowa State College, Ames, who will extract from the physicists' papers important points that can be applied to civil engineering materials and design.

On the same day this symposium is presented, the Engineering Mechanics Division will hold a joint luncheon with the Structural and Sanitary Engineering Divisions. The luncheon speaker will be Carroll V. Roseberry, Manager, Commercial Atomic Power Activities, Westinghouse Electric Corporation. His subject will be the general aspects of atomic power, with attention to some of the difficult problems that arise in sewage disposal of atomic waste, in shielding, and in engineering mechanics in connection with high pressures, high temperatures, and corrosion.

Those interested in engineering mechanics will find this symposium and luncheon an informative and inspiring occasion.

Help Sought on Report of Wind Forces Committee

The Committee on Wind Forces of the Structural Division is preparing a report for the Society, which will summarize and correlate existing information on wind forces in a form that will be of practical use to the engineer. A preliminary draft of the report will be completed by the fall of 1956. Comment and criticisms of this draft by qualified members of the Society will be of great assistance to the committee in preparing a report for general distribution.

Members interested in preparing such a review for the use of the Committee on Wind Forces are asked to write to Chairman John M. Biggs, Room 1-230, Massachusetts Institute of Technology, Cambridge, Mass.

ASCE Members Feted During World Power Conference

Contingent of ASCE members and their wives attend reception in the City Hall in Vienna, tendered to delegates to the World Power Conference. Shown here (clockwise around the table) are Mrs. George Palo, Knoxville, Tenn.; Mr. and Mrs. Francis S. Friel, Philadelphia; ASCE Past-President Gail Hathaway, Washington, D.C.; Mr. Palo; and Mr. and Mrs. Frank Weaver, Washington, D.C.

ASCE Highway Division Studies Proposed Road Program

Executive Committee of the Society's Highway Division meets in Washington to discuss the role of ASCE members in the proposed highway construction program. A promising program was worked out in the all-day session by (seated, left to right) Harmer E. Davis, director of the Institute of Transportation and Traffic Engineering, University of California, and vice-chairman of Executive Committee; J. P. Buckley, chief engineer, Highway Division, Automotive Safety Foundation and secretary of Executive Committee; Emmett H. Karrer, professor of civil engineering at Ohio State University and chairman of Executive Committee; B. D. Tallamy, chairman, New York State Thruway Authority; A. N. Carter, manager, Highway Contactors' Division, Associated General Contractors of America; and Don P. Reynolds, assistant to the Secretary of ASCE. Standing, in same order, are S. E. Ridge, chief, Maintenance Control Section, Bureau of Public Roads, and chairman of ASCE Committee on Cooperation with Local Sections; D. W. Loutzenheiser, chief, Urban Highway Branch, Bureau of Public Roads, and member of ASCE Committee on Geometric Design; Carl E. Fritts, vice-president for highways, Automotive Safety Foundation, and chairman of ASCE Committee on Highway Engineering Manpower; and George H. Leland, Edwards, Kelcey & Beck, Newark, N.J., and editor of the ASCE Highway Division Newsletter.

Sanitary Engineers Can Now Apply for Certification

After more than five years of effort to provide for the certification of sanitary engineers, the program of certification has begun, as indicated by the receipt of the first application for a certificate of special knowledge in sanitary engineering. This application "marks the beginning of the first program of certification of special engineering knowledge in any of the several engineering specialties," announced Prof. Earnest Boyce, M. ASCE, of the University of Michigan's College of Engineering, who is chairman of the Board of Trustees of the certifying agency, the American Sanitary Engineering Intersociety Board, Inc. (ASEIB).

The objective of the ASEIB is to improve the practice, elevate the standards, and advance the cause of sanitary engineering. A means toward this end is the certification of those sanitary engineers who meet the criteria established by the organization. All certified sanitary engineers will be carried on a roster, known as the American Academy of Sanitary Engineering. Basic requirements for certification are registration as a professional engineer, graduation from a college of engineering, and at least 8 years of sanitary engineering experience.

Eligibility will be determined on the basis of the applicant's education, experience, and an oral and written examination. Applicants with unusually high qualifications and at least 15 years of experience may be considered for certification without examination if their applications are filed before July 1, 1957. All applicants are required to pay an application fee of $10 plus an examination fee of $25.

ASEIB is sponsored by the American Public Health Association, American Society of Civil Engineers, American Society of Engineering Education, American Water Works Association, and Federation of Sewage Works Associations. Inquiries should be addressed to the Secretary of ASEIB, Francis B. Elder, M. ASCE, whose office is in the Engineering Societies Building, 33 West 39th Street, New York 18, N.Y.

NOTES FROM THE LOCAL SECTIONS

(Copy for these columns must be received by the tenth of the month preceding date of publication.)

Central Illinois Section members recently heard an informative talk on foundation problems encountered in building various hydraulic structures in the lower Mississippi Valley. Featured speaker was Normas R. Moore, chief of the Engineering Division of the Mississippi River Commission and nominee for ASCE Vice-President. Another feature of the meeting—the annual joint session with the University of Illinois Student Chapter—was the presentation of Section awards to three outstanding Student Chapter members. The honored students are Eugene L. Joerns, Otis E. Michels, and Raymond L. Miles.

Illinois Section members enjoy trip to Portland Cement Association's Research Laboratories in Skokie. Group was welcomed by A. A. Bates, who described the laboratory's role in cement and concrete research. Laboratory tour included inspection of a one-to-three model of the continuous haunched Air Force warehouse roof girders that recently failed in service. Richard Elstner read a paper on recent research conducted to pinpoint the cause for such beam failures.

Typical construction jobs for industry, in which pre-planning, prefabrication, and automation have effectively reduced costs, were discussed and illustrated (with slides) at a recent **Cincinnati Section** meeting. The experts were staff members of the H. K. Ferguson Company—Wayne S. McDaniel, chief engineer of the Cincinnati Division; Claude F. Reynolds, planning assistant of the company; and Ray Blackwell, company engineer. Section awards of Junior Membership in the Society were presented to Philip Borge and Andrew R. Barkocy, of the University of Cincinnati.

Richard Speece should have been announced as first Fenn College winner of the G. Brooks Earnest Junior Membership Award, in the description of the award in the June issue (page 75). James I. Taylor, of Case Institute, was the other recipient of this new prize set up by G. Brooks Earnest, president of Fenn, with income from a gift purse received from the **Cleveland Section** in recognition of his five years of service on the ASCE Board of Direction. Speakers at another recent Section meeting were ASCE Director Don M. Corbett, who described problems currently before the Board, and Albert S. Porter, Cuyahoga County engineer, whose subject was the development of county freeways.

In a "Sermon for Young Engineers," delivered at a joint meeting of the **Connecticut Section** and the University of Connecticut Student Chapter, Brig. Gen. Robert J. Fleming, New England Division Engineer of the Army Corps of Engineers, stressed the need for engineers to take their proper place in society and as citizens, rather than merely burying themselves in their jobs. Checks for $10 went with the Section's compliments to James Skilton, outstanding civil engineering senior at the University of Connecticut, and to Donald J. Ross, outstanding senior at Yale University.

The **Dayton Section** reports that its first dinner-dance-meeting was an unqualified success. ASCE Director Don Corbett was after-dinner speaker, with a talk on recent Society trends. Mrs. Corbett pleased the group, too, with a few special words to the ladies.

Informal discussion of Section business and other non-technical matters occupied the attention of **Georgia Section** members attending the June meeting, which was held at the Decatur home of Moses Cox. Among subjects covered was the Section's

support of the proposed Architects and Engineers Institute to be located in Atlanta. The Section is recessing until the first Friday in September. A description of the administrative structure of the Society—given by E. S. Kirkpatrick, assistant to the Secretary of ASCE—provided the technical program for a meeting of the Central Savannah River Valley Branch held in Augusta on May 31. Branch meetings are suspended for June, July, and August.

Entering ASCE are six young men from engineering schools in the Chicago area who received certificates of Junior Membership from the **Illinois Section** in the recent commencement season. Those honored were Miroslaw Noyszewski and Robert K. Waddick, University of Illinois; George W. Blomme and John F. Seidensticker, Northwestern University; and John R. Carlson and Richard C. Vankrevelan, Illinois Institute of Technology.

The application of electronic computers in structural work was interestingly described at the May meeting of the **Indiana Section's Northwestern Branch.** Featured speaker was C. W. Zahler, engineer for the American Bridge Company and a pioneer in the solution of engineering problems with electronic computers.

In June the **Intermountain Section** celebrated the fortieth anniversary of adoption of its constitution (on June 3, 1916) by launching a mimeographed newsletter. The auspicious new news sheet provides wide coverage of Society and Section affairs. At a recent meeting the Section awarded Junior Membership in the Society and Junior pins to the outstanding civil engineering graduates in its Student Chapters—Curtis R. Allen, of Utah State Agricultural College, and George Aposhian of the University of Utah.

At a joint meeting of the **Iowa Section** and the Iowa State College Student Chapter, held at Ames in May, ASCE Director C. L. Eckel discussed the education and work of the civil engineer. Dean Eckel also presented the Chapter with the Society's Certificate of Commendation (the twelfth to this Chapter) for its 1955 activities. For the sixth consecutive time the Chapter has been the winner of the Engineering Openhouse display during Veishea 1956. The theme of this year's display was the Seven Civil Engineering Wonders. Chapter President Merwin Dougal presented the plaque won by the Chapter to Prof. Lowell O. Stewart, secretary-treasurer of the Section and head of the civil engineering department.

Outstanding civil engineering students in Kansas colleges receiving **Kansas Section** awards of Junior membership in ASCE during the recent commencement season were Martin K. Eby, Jr., of Kansas State College, and Philip Altimari, of the University of Kansas. Presentation of the awards took place at a joint meeting of the Section and the Student Chapters held late in May. Featured speaker was Willem Vanderbyl, associate professor of physics at Kansas State and an exchange teacher from Holland. Dr. Vanderbyl's subject was the effect of solar disturbances on the weather.

Kentucky Section members held their May dinner meeting at the Beargrass Creek Pumping Station of the Louisville Flood Protection Works. Preceding a tour of the plant, Roy Karlen, assistant chief of the Engineering Division of the Louisville District of the Corps of Engi-

Maine can expect to gain much from the passage of the Fallon highway bill, John A. Volpe, Massachusetts Commissioner of Public Works, told the Maine Section at its meeting in Scarboro on April 21. This bill (since passed by Congress) would mean a $150 million potential for Maine highways, and be a source of great advantage to the state in its role as vacation host, he stated. This noteworthy talk gained interest from the fact that the speaker was one of the outstanding workers for the bill. The attendance of 90 at this meeting made it one of the best attended ever held by the Section. Earlier in the day the Section, jointly with the Maine Association of Engineers, gathered at the docks of the Portland Pipe Line Corp. in South Portland for an inspection of the installation for oil handling, from unloading through storage and pumping, to discharge of the crude oil to Montreal. A tour was also made of the S. D. Warren Co. paper mill in Westbrook.

John N. Robertson (second from right), president of American Road Builders Association, is featured speaker at annual meeting of National Capital Section, devoted to highway engineering problems. Shown with him are (left to right) Daniel B. Ventres, new Section president; C. D. Curtiss, commissioner of the U. S. Bureau of Public Roads; Mr. Robertson; and Bernard F. Locraft, outgoing Section president. Mr. Robertson said that highway engineers must be emancipated from subprofessional and non-professional duties and suggested ways of keeping them free for the professional work they alone can do. Other new Section officers for the year beginning July 1 are Archie Carter, vice-president; Alfred R. Golze, secretary; and James Stout, treasurer.

ASCE President Enoch R. Needles discusses California water problems with San Francisco Section luminaries at recent Section meeting. View shows (left to right) Section President Robert D. Dewell; Lawrence Elsener, ASCE Director for District II; President Needles; and ASCE Past-President Walter Huber. In the background there is a map of California's Feather River Project, which was discussed by Walter Schulz at the May meeting.

neers, supplied facts and figures for a background. Contributing also to the success of the meeting were W. W. Sanders, Louisville city engineer, and S. M. Bailey, chief of the Engineering Division of the Louisville District. The Section voted to defray the cost of a linoleum replica of the ASCE Student Chapter badge in the floor of the central hallway of the new William S. Speed Building at the University of Louisville.

Publication details of an important new Section news bulletin are being worked out by the **Maine Section.** Called "The Yankee Engineer," the comprehensive 12-page newsletter will be issued on a quarterly basis, with the first issue scheduled for September 1. The staff will consist of the president of the Section, Charles Parker, as editor-in-chief; Richard W. Shields as managing editor; George S. Elliott, Jr., as business manager; and a contributing editor from each Branch.

Water and sewage works design from the operator's viewpoint was the topic of the June meeting of the **Metropolitan Section's** Sanitary Engineering Division. On the panel of experts were F. H. Lino, superintendent of New York City's Owls Head Treatment Plant; James M. Brown, superintendent of the New Rochelle Treatment Plant; Sigvald Steffenson, chief of the New York City Bureau of Sewage Design; and Charles Velzy, partner in Nussbaumer, Clark and Velzy. Unanimously elected to the executive committee for a three-year term were Eugene A. Hardin, New York City consultant, and Wilbur N. Torpey, of the New York City Department of Public Works.

Another successful spring meeting has passed into Mid-South Section history. This spring the **Little Rock Section** was host at Little Rock to about 100 members and their wives from Arkansas, Mississippi, and Tennessee, and some 30 students. ASCE Director E. W. Carlton attended the entire meeting, and presented a timely paper on "Human Relations." Students were accorded an important place on the program, which featured technical papers by three Student Chapter members and Robert Lipp's prize-winning paper in the current Daniel Mead Award contest. Award of Merit certificates and $30 checks were presented to three outstanding students: Grady F. Riley, of Mississippi State College; Carl S. Downing, of the University of Mississippi; and Thomas E. Taylor, of the University of Arkansas.

After hearing Samuel L. Diack, president of the Oregon Museum of Science and Industry, discuss the museum at its May meeting, the **Oregon Section** presented Dr. Diack with a $100 check as its contribution to the museum building fund. Dr. Diack's talk was entitled, "Engineering, Our Children's Future."

The present unlimited opportunities for young civil engineers were stressed by ASCE President Enoch R. Needles and Director Oliver W. Hartwell at the May meeting of the **Philadelphia Section's** Central Pennsylvania Branch. To be successful in any profession, said Mr. Needles, one "must have the proper combination of education, enthusiasm, courage, and avowal." An excellent paper on sonic testing methods was presented by three civil engineering students from Bucknell University, who made the point that with the sonic method ultimate strengths can be obtained without destroying or even disturbing the existing structure. The following new officers were installed: James A. Romano, president; John J. Molloy, vice-president; and Floyd L. Nelson, secretary-treasurer.

An excellent program built around the theme of soil mechanics was arranged and put on by the **Pittsburgh Section's** Junior Member Forum for the Section's May meeting. Featured speakers were Anthony M. DiGioia, senior civil engineering student at Carnegie Institute of Technology; Arthur P. Jentoft, of the Booth and Flinn Company; and Gerald A. Oakes, soils engineer with Richardson, Gordon and Associates. Mr. DiGioia received one of the Section's annual awards of Junior Membership in ASCE, and the other one went to Glen R. Heiskell, of the University of Pittsburgh.

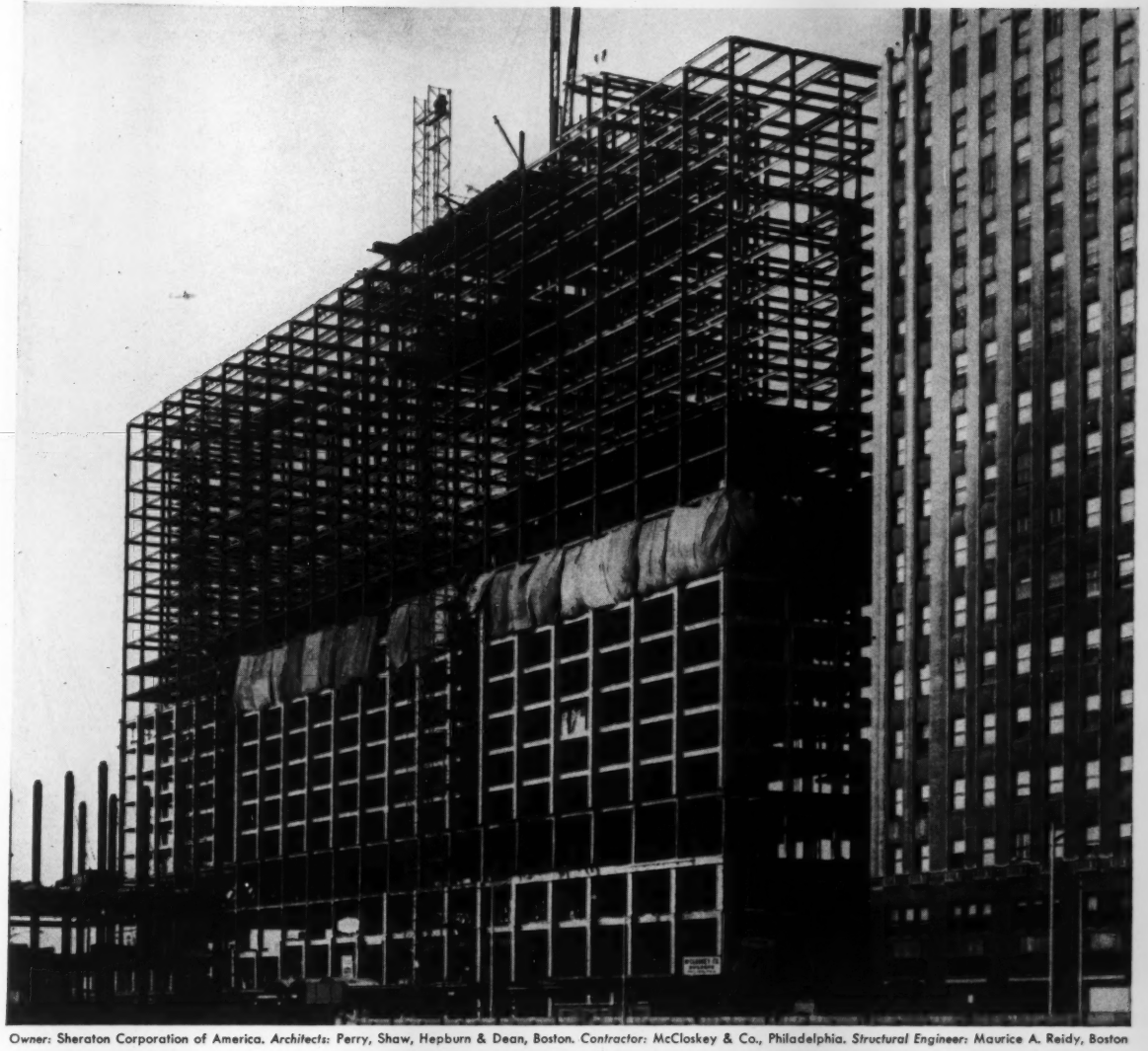
As announced in the abstract of the Board of Direction's activities at Knoxville (July issue), the **Syracuse Section** now has a **St. Lawrence Branch** to take care of members' interests in its northwestern area. Branch officers will be Luther E. Cliffe, president; Judson P. Elston, vice-president; and Gerald G. Leach, secretary-treasurer. Recently elected Section officers for the coming year will be Bernard Dawson, president; J. Clyde and T. Dickerson, vice-presidents; and F. T. Sendker, secretary-treasurer. In May the Section undertook its most successful field trip, an all-day tour of the wonders of the St. Lawrence Project. Credit for the success of the trip is being given to the "inspiration and initiative of the old and new secretaries, Walter Neubauer and Bob Sendker." Robert Brown and J. T. Hendricks, both of Uhl, Hall and Rich, acted as guides to the group and described the project.

Scheduled ASCE Conventions

PITTSBURGH CONVENTION
Pittsburgh, Pa.
William Penn Hotel
October 15–19, 1956

JACKSON CONVENTION
Jackson, Miss.
Hotel Heidelberg
February 18–22, 1957

BUFFALO CONVENTION
Hotel Statler
June 3–7, 1957



Owner: Sheraton Corporation of America. *Architects:* Perry, Shaw, Hepburn & Dean, Boston. *Contractor:* McCloskey & Co., Philadelphia. *Structural Engineer:* Maurice A. Reidy, Boston

First Building in Philadelphia Erected With High-Strength Bolts

Here, shown under construction, is the Sheraton Hotel, the first multi-storied structure to be erected in Philadelphia by means of time-saving high-strength bolting. Bethlehem High-Strength Bolts connect the structural members of its 3900-ton framework.

The 21-story hotel is part of the Penn Center development in the heart of downtown Philadelphia. It has three floors of public rooms, 1000 guest rooms, and a top story of luxury suites with balconies, including a Presidential Suite.

Bethlehem High-Strength Bolts save time in steel erection because the joints can be made rapidly. In fact, a high-strength bolt, used with hardened washers, can be installed in seconds. While a holding wrench grasps the bolt-head, the nut is driven to predetermined tension with a calibrated pneumatic impact wrench. It's that simple!

Besides, with high-strength bolting, there's no fire hazard involved. And the bolting operation is less noisy than riveting, making it an ideal erection method for hospital and school zones.

Bethlehem High-Strength Bolts are made of carbon steel, and are heat-treated by quenching and tempering, to meet the requirements of ASTM Specification A-325. They are furnished in sizes to meet every construction need.

If you would like to have full information about erecting steelwork with Bethlehem High-Strength Bolts, please telephone the nearest Bethlehem sales office. Or write direct to us at Bethlehem, Pa.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

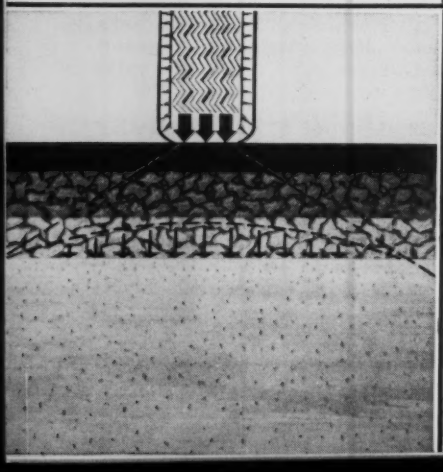
BETHLEHEM STEEL

BETHLEHEM STEEL

Make Asphaltic Concrete YOUR

Hugs earth—spreads load

No subgrade stays perfect. Asphaltic concrete adjusts to variations as they develop . . . hugs its foundation . . . distributes loads and impact broadly . . . lowers internal stresses.



Savings pay maintenance

Table below reports Oklahoma's saving on paving Turner Turnpike with Asphalt. It's enough for 65 years maintenance at today's prices.

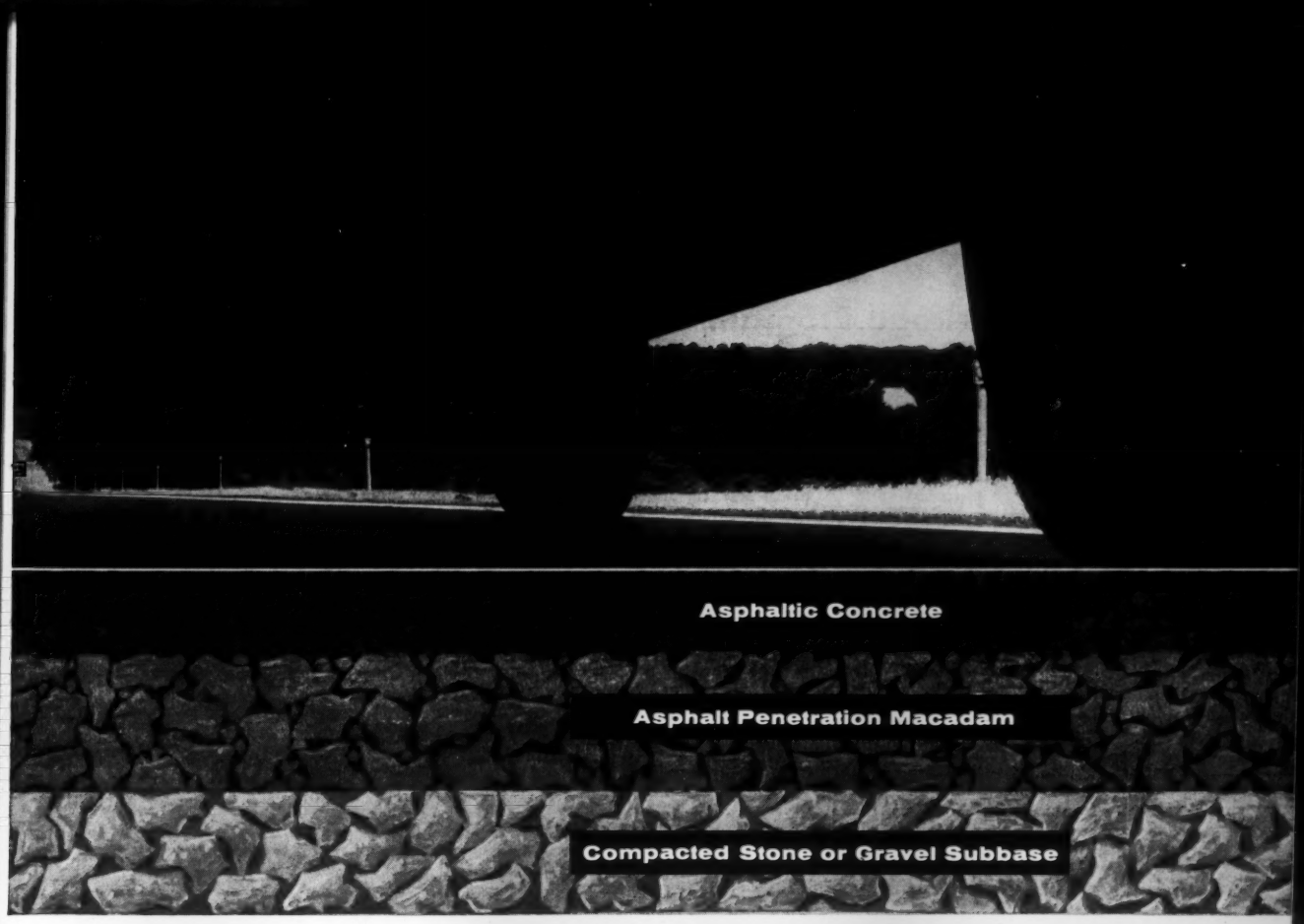
BID PRICES BY CONTRACT SECTIONS
THE TURNER TURNPIKE—
OKLAHOMA CITY TO TULSA
(Awards by the Oklahoma Turnpike Authority)

CONTRACT NUMBER	MILES	ASPHALT	ASPHALT SAVING
#34	4.53	$ 491,636	$ 57,529
#39	5.93	615,131	96,241
#40 (A&B)	7.98	941,343	94,070
#41	5.65	608,269	99,545
#42	3.38	351,115	58,098
#31	7.83	883,098	105,545
#32	8.04	902,231	112,027
#37	4.94	548,641	67,563
#38	7.61	848,181	110,956
#17	9.03	957,213	136,890
#18 (A&B)	9.05	1,097,599	131,979
#33	8.61	1,046,907	90,677
TOTAL	82.58	$9,291,364	$1,161,120

The Turner Turnpike was designed to carry axle loads of 28,800 Pounds

Capacity easily upped

Many states are planning to modernize in easy stages with Asphaltic concrete . . . adding lanes and extra strength as need develops. They're also renewing older roads with minimum traffic interruption and cost.



pavement on interstate highways

The talk is over. Next step is building your State's sections of the Interstate Highway System.

Question now is *which* paving? Which meets the engineering requirements with the greatest economy?

The facts favor Asphaltic concrete.

Take engineering requirements. Findings on the WASHO Road Test show that standard Asphaltic concrete designs provide all-weather roads able to carry the heaviest legal truck axle loads, AND MORE!

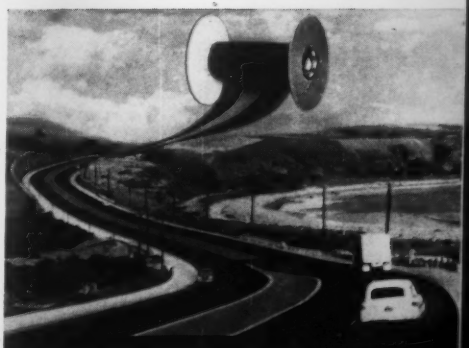
Photo shows why. Asphaltic concrete *spreads* wheel loads, has built-in resilience to take traffic pounding. It withstands temperature changes, conforms to settlements without fracturing. It repels moisture, melts off ice and snow more quickly, isn't harmed by wintertime use of chemicals.

Take first cost. Here are figures showing Asphalt savings based on actual competitive bids. New Jersey Turnpike (118 miles) $5,457,134 saved. Oklahoma Turnpike (33 miles) —see table at left—$1,161,120 saved. Savings like these pay for years of maintenance . . . or allow more and wider road for the money.

Take maintenance. It's always low with Asphaltic concrete. It's easier too, and much faster.

And when future loads and traffic volume increase as they inevitably will, just add another course of Asphaltic concrete. This builds up thickness and strength.

Plan for Asphaltic construction. You'll have smooth going . . . during construction . . . on the road . . . with the taxpayers.



THE ASPHALT INSTITUTE
Asphalt Institute Building
College Park, Maryland

NEWS BRIEFS . . .

The National Road Program—A Challenge and an Opportunity

In carrying out the recently enacted multi-billion-dollar highway program, civil engineers once again have the obligation and the opportunity to prove their mettle. Naturally the new program will create more jobs for highway engineers, and naturally it will upgrade their status. More than that, the profession will benefit, along with the rest of the population, from the social and economic implications of the program as well as from the nation-wide net of better and safer roads it will provide.

Called the greatest single public works undertaking in history, the pay-as-you-go program emphasizes completion and improvement of the Interstate Highway System and authorizes $24.8 billion in federal-aid funds for the purpose. These funds will be matched by $2.8 billion in state funds. In addition, the new legislation authorizes stepped-up federal aid for primary, secondary, and urban systems, and provides for the purpose $2.55 billion in funds for each of the next three fiscal years (plus $700 million available under the 1954 act).

Under the new program the Interstate Highway System will be expanded to a 41,000-mile net of superhighways connecting the state capitals. The interstate network will also connect all but 23 of the 232 cities with populations of over 50,000. For building and rebuilding the interstate system, the highest standards of construction and safety are stipulated, and the finished network must meet 1975 traffic demands. The network is to be completed simultaneously in all the states over a thirteen-year period.

The government's share of the interstate program will be apportioned for three years on the usual federal-aid formula (size, population, and postal road mileage). Apportionment for the remaining ten years will be on the basis of remaining Interstate Highway System needs, which will be determined by periodic joint surveys made by the Bureau of Public Roads and the State Highway Departments.

Total apportionment to the states for the period 1957 to 1959 will be $6.5 billion. The four top allotments for the same three-year period are $451.2 million to New York; $381.8 million to Texas; $367.5 million to California; and $341.3 million to Pennsylvania. For the first time, Alaska will be eligible for federal aid for its primary, secondary, and urban systems.

To pay for the government's share of the highway program, there will be new taxes amounting to $14.8 billion over a sixteen-year period. The additional imposts include an increase of a cent a gallon in the federal tax on gasoline (non-highway users will be exempt); new taxes on fuels other than gasoline; a new tire tax; and additional taxes on trucks, buses, and trailers. Vehicles with gross weight of over 26,000 lb will be taxed $1.50 annually for each thousand pounds in excess of this weight. A Highway Trust Fund is being set up to handle and administer the funds collected.

One of the prime benefits of the highway program will be increased highway safety. Last year the death toll on our streets and highways reached 38,300, and the toll of injured was 1,350,000. The Automotive Safety Foundation estimates that modernization of the Interstate System alone will save 3,500 lives a year and correspondingly reduce the number of injured.

Easing the traffic situation will be another obviously important benefit. The Bureau of Public Roads notes that about 80 percent of our population drives to work. "Considering only the Interstate System," it says, "this network will get millions of people out of daily traffic jams as they go to and from the job."

The economic impact of the program is beyond immediate realization. The Associated General Contractors reports that contractors polled expect that, at its peak, the program will provide employment for nearly 900,000. Of course, too, there will be greatly increased demands for cement, for aggregates, for bituminous materials, and for steel. Finally, there will be unprecedented community expansion and development in the wake of the new roads.

To help the average person comprehend the size of a 33-billion-dollar single construction program, all kinds of highway organizations are making all kinds of graphic comparisons. In thirteen years, they point out, the new program will see finished the 41,000-mile Interstate System; modernization of several hundred thousand miles of other roads; and erection of 300,000 bridges and other structures. In contrast, the Roman Empire required 500 years to build its celebrated 50,000-mile network of roads. More recently, the Panama Canal cost only $375 million, but was fourteen years in the building, and the St. Lawrence Seaway, now under construction, will cost a mere $600 million. The proposed huge Aswan Dam on the Nile, a 600,000-cu yd rock fill, is expected to cost $1 1/3 billion and to take upward of 20 years to complete.

Welded Design for Bridge Over Columbus Reservoir

Indicative of a trend towards the use of welded designs for bridges is this service road over Hoover Dam Reservoir, City of Columbus, Ohio. Project features eight 85-ft 3-in. spans of 100 percent welded haunched plate girders and has a 24-ft-wide roadway and two 1 1/2-ft safety curbs. Design was prepared by Burgess & Nipple, Columbus consulting firm. The general contractor was the J. E. Jones Construction Company, Charlotte, N. C., and the fabricator the C. E. Morris Steel Company, Columbus. Of 29 state highway departments responding to recent survey made by the James F. Lincoln Arc Welding Foundation, 72 percent report using either all-welded design or welding for certain details of bridge projects. Reported savings in steel in typical structures ranged up to 20 percent.

U.S. Loan to Expand Mexican Steel Plant

An Export-Import Bank loan to private enterprises in Mexico will be spent for steel mill expansion and improvement. Cia Fundidora de Fierro y Acero de Monterrey, S.A., one of the country's largest steel plants, will receive a loan of $26,000,000 for a modernization and expansion program that includes the formation of a new subsidiary company to produce flat steel products.

Some of the loan will be applied toward purchase of equipment in the United States, including a 46-in. high-lift blooming and slabbing mill, a continuous reheating furnace and cranes, two soaking pits, a 50-ton stripper crane, a turboblower, and open-hearth (250-ton) furnace, and a flat products mill. Total cost of the expansion program will be upwards of $35,000,000.

Joint Headquarters for Two Government Bureaus

Construction of a four-building project to serve as a combination headquarters for the U. S. Weather Bureau and the U. S. Coast and Geodetic Survey has been approved by the Bureau of the Budget. The new project, planned by the Public Buildings Service of the General Services Administration, will provide a multi-story main building, a garage, an observatory, and an archives-storage and shop building. Common facilities for the two agencies are expected to yield substantial savings in construction and operating costs. Estimated construction cost of the joint project is $30,990,000.

Record Construction Total Foreseen for 1956

Outlays for new construction are expected to total $44½ billion in 1956—4 percent above last year's record of $43 billion—according to revised estimates prepared by the Departments of Labor and Commerce. These revised estimates are pretty much in line with the $44-billion level foreseen for 1956 by these agencies last November. Present indications are that, compared with earlier expectations, new housing will decline more, but utilities, private industrial buildings, and highways, will show greater gains.

The present outlook for construction assumes that the current high level of overall economic activity will remain relatively stable, and that disposable income of consumers will continue at record levels. Nationwide supplies of building materials should be adequate, with increased plant capacity and high productivity preventing all but minor or spot shortages. Construction costs are expected to continue to rise moderately.

Prospects are that private construction outlays in 1956 will total about the same as in 1955—$31 billion. Public spending for new construction is expected to advance 9 percent to $13½ billion. Private spending for new industrial plant expansion may reach the $3 billion mark, and new commercial building outlays probably will exceed $3.4 billion. All other types of construction are likely to show at least a slight gain in 1956, except hospital construction (private and public), farm construction, and public industrial building.

Construction of public service enterprises is scheduled for a substantial advance, reflecting largely gains in work put in place on power and other facilities connected with the St. Lawrence Seaway. Construction of public schools and sewer and water facilities will probably advance to an all-time high.

It is anticipated that expenditures for military facilities will continue to rise this year. Outlays for public housing (including Title VIII military housing) and for conservation and development projects are expected to increase for the first time in several years.

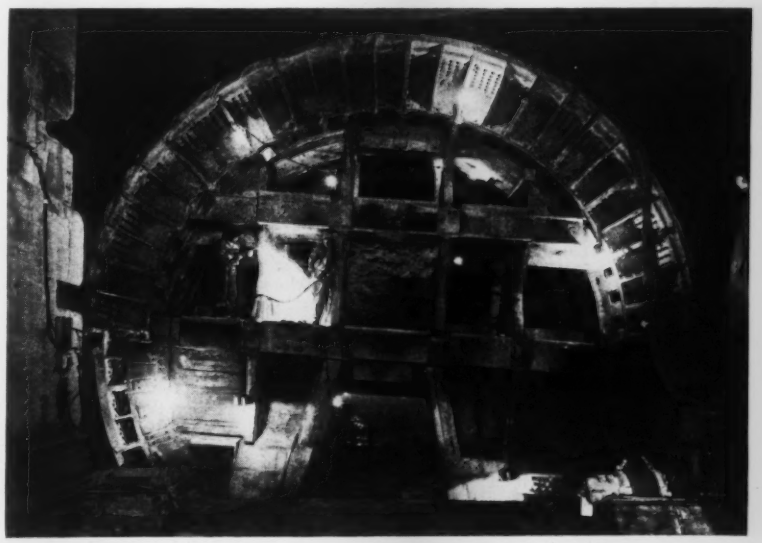
Third Tube of Lincoln Tunnel Holed Through

In a ceremony marking the holing through of the third tube of the Lincoln Tunnel, on June 28, Governors Averell Harriman of New York and Robert B. Meyner of New Jersey tightened the last bolt of the last steel ring to be placed in this shield-driven tunnel. The shield began its 5,486-ft journey at the New Jersey shaft on November 9, 1954, and reached the New York shaft June 28, 1956. In all, 2,031 steel rings were placed in the tube. All concerned with the driving of the tunnel—a Port of New York Authority project—expressed themselves as proud and thankful that there were no fatal accidents in the entire nineteen months of this hazardous phase of construction.

During the driving the shield took in about 20 percent of the volume of river muck displaced, using it as ballast. The remaining 80 percent was pushed aside. Attesting to the accuracy of the driving is the fact that the shield was landed at the Manhattan shaft on grade and only ¾ in. off line.

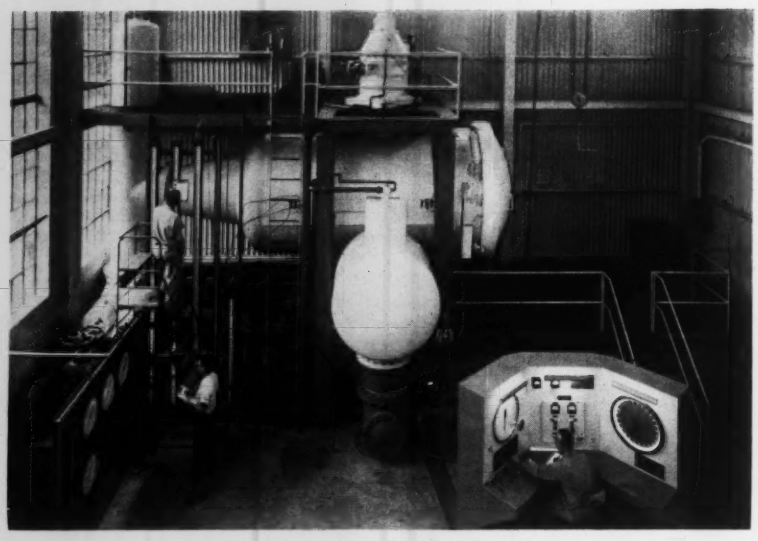
When completed in the spring of 1957, the third tube will double the peak capacity of the tunnel and increase annual capacity by 50 percent. The present south tunnel, which will become the middle tunnel in the new tube set-up, will be east bound in the morning and west bound at night.

Total cost of the third tube project will be in the neighborhood of $100,000,000.



Shield used in driving third tube is shown as it reaches New York side. With 28 hydraulic jacks around its edge, each thrusting forward with force of 200 tons, shield moved 32 in. in a step. After each step a new ring of the permanent outer shell was constructed behind the shield.

New High-Head Turbine Test Stand Completed



S. Morgan Smith Company's new high-head turbine test stand, designed for primary function of obtaining accurate and reliable quantitative results, will increase effectiveness of laboratory testing of turbine designs. Project was designed by company engineers.

Recently the S. Morgan Smith Co. unveiled its new 300-ft-head turbine test stand at York, Pa. The new testing facility will provide two valuable conditions increasing the effectiveness of laboratory testing of turbine designs. First, lower sigma values $\left(\sigma=\frac{H_b-H_s}{H}\right)$ can be obtained more easily with the higher head, thereby allowing cavitation tests to be conducted conveniently even on Francis runners in the low specific speed range. Second, field conditions of head and sigma can be duplicated for all Kaplan and propeller designs and for many Francis designs, permitting more thorough investigation of actual operating conditions.

The repeatable accuracy of the stand is considered to be plus or minus one-quarter of 1 percent. The absolute accuracy, considering the accurate calibration, is within 1 percent.

A unique feature of the high-head test stand is the suspension of the test unit. The entire wheel case, including wicket gates and operating mechanism, stay ring, bottom ring, and head cover, is suspended from the dynamometer frame and is entirely independent of the head tank and other components of the pressurized system. This is accomplished by attaching the wheel case to a cylindrical barrel, located in the head tank but separated from it by means of music-note rubber seals. The advantage of this mounting is that any breathing or other movement of the pressurized tanks will not affect the alignment of the runner shaft which is also attached to the dynamometer, and consequently excessive bearing wear and accompanying extra friction loss and other difficulties are eliminated.

The new stand is used for basic research and the conduct of formal contract acceptance tests with particular emphasis on the duplication of field conditions.

The Francis runner, wicket gates, and stay vanes for the Brownlee Development of the Idaho Power Co. were developed in this new test stand. This will be the first plant constructed for the Hell's Canyon Project. The four prototype units are rated at 144,000 hp, under a net head of 250 ft at 128.6 rpm.

In a second interesting application the stand was used to increase the power output of the Gorge Powerhouse for the City of Seattle. The existing units, built in 1921, were rated at 27,500 hp at 275-ft net head and 257 rpm. They were capable of 37,500 hp at 325-ft head. Through tests on the high-head stand it was possible to increase the power output to 47,500 hp at full gate (45,000 hp at 87.5 percent efficiency) without appreciably changing the runner and wicket gate dimension.

A paper giving a complete description of the new test stand will be presented at the ASCE Convention in Pittsburgh next October.

Automation Speeds Highway Engineering Computations

The use of electronic computers as an important means of conserving manpower for engineering purposes was emphasized at a recent two-day conference on automation in highway engineering held on the Louisiana State University campus and sponsored by the LSU Department of Civil Engineering and College of Commerce and the Louisiana Department of Highways. The meeting, which was attended by engineers, educators, and accountants from fourteen states, covered methods of converting rod readings to actual elevations, computing grades over vertical curves, computing elevations of superelevated and widened curves, and computing areas and volumes from field notes.

In a leading talk, F. J. Germano, head of the civil engineering department, told the group that the Louisiana Department of Highways was "the first to show that volumes of earth for highway construction can be obtained from field notes seven times as fast by electronic computers as by the conventional, tedious methods." N. P. Himbert, auditor for the Louisiana Highway Department, reported that the accounting section is saving $20,000 a year on accounting alone since conversion to the use of electronic computers. S. E. Ridge, of the Bureau of Public Roads, Washington, was another featured speaker.

ASTM Elects Officers And Bestows Honors

Rudolph A. Schatzel, vice-president and director of engineering for the Rome Cable Corp., Rome, N. Y., is new president of the American Society for Testing Materials. Kenneth B. Woods, M. ASCE, head of the School of Engineering at Purdue University and director of the Joint Highway Research Project there, has been elected vice-president for a two-year term. New directors, elected for three years, include two members of ASCE—Miles N. Clair, president of the Thompson & Lichtner Co., Inc., Brookline, Mass., and R. R. Litehiser, engineer of tests for the Ohio State Highway Testing Laboratory, Columbus. The new slate took office during the 59th annual meeting of the ASTM, held in Atlantic City in June.

Another feature of the program was the presentation of honorary memberships in the ASTM to several distinguished engineers, including Herbert J. Gilkey, M. ASCE, who is head of the department of theoretical and applied mechanics at Iowa State College. Professor Gilkey is eminent as both a teacher and research engineer in the field of concrete. Among eleven technical leaders in the field of engineering materials receiving Awards of Merit was H. F. Gonnerman, M. ASCE, research consultant of Oak Park, Ill.

Better Education for Engineers Urged at ASEE Meeting

A five-point program to increase the nation's resources of engineers and scientists through more effective education was laid before members of the American Society for Engineering Education at the organization's 64th annual meeting held at Iowa State College late in June. Maynard M. Boring, president of the ASEE and consultant on engineering manpower for General Electric, told the 1,300 members in attendance that, "The demands of industry clearly indicate that quality rather than quantity is needed."

Deploring the national "hysteria concerning the manpower problem," Dr. Boring declared that secondary education holds the key to increasing the numbers and competence of engineering graduates. "During this century," he went on to say, "our public schools have been forced into an educational program that is geared to the average youngster. The teaching of mathematics and science has degenerated enormously."

These, said Dr. Boring, are the steps that must be taken:

1. We must increase the efficiency of our educational program. "Approximately 50 percent of the students qualified for professional work," he pointed out, "do not go beyond high school, and we lose nearly 50 percent of those who start professional work in college."

2. Engineering colleges should stiffen their entrance requirements, to assure that their entering students will be better prepared and to encourage higher standards throughout secondary education.

3. High schools and colleges alike should greatly improve their guidance activities.

4. Financial resources for education must be improved. "Since taxpayers are already burdened, industry will have to help," Dr. Boring observed.

5. The professional recognition of teachers must be achieved early in their careers.

Studies in science, engineering, and technology, despite their importance, are not enough. Speaking for a special survey committee reporting on the place of the humanities in engineering education, Edwin S. Burdell, president of Cooper Union, emphasized that, "Engineering schools have the responsibility to develop in the undergraduate a capacity for both intellectual and emotional growth in directions which we ourselves can today but dimly visualize; he must have technical skills, and he must have as well an understanding of himself and of the world about him." To achieve this aim, Dr. Burdell said, requires a program of social and humanistic studies which is an "integral part of each student's educational experience."

Engineering educators were in agreement that their students need a fuller acquaintance with the humanities and social sciences, though some expressed fear of the effect on already crowded curricula.

Nuclear science must be taught

Every engineering student today should know the fundamentals of nuclear science. Regardless of what he thinks he will do after graduation, he is likely to find himself a "nuclear engineer" in tomorrow's broadening technology. This viewpoint was emphasized by V. Lawrence Parsegian, professor of nuclear engineering at Rensselaer Polytechnic Institute, who told the group that "The present tendency to look on nuclear engineering as a separate professional subdivision imposes undesirable barriers and will impede its progress." Dr. Parsegian said that, "The atomic program is likely to be the most important of the factors that will determine the pattern of engineering education for the next few decades."

The "Pickle Barrel," a subcritical nuclear reactor designed by the physics staff of New York University, was on display. This new teaching aid is expected to have growing importance as nuclear engineering increases its invasion of the nation's engineering schools.

New research projects

A comprehensive study of the nation's engineering research needs will be undertaken by the ASEE with a special grant of $40,000 made available by the National Science Foundation. Eric A. Walker, vice-president of Pennsylvania State University, will direct the project. Announcement was also made of plans for a study of technical institute education in the United States to be underwritten by the Carnegie Corporation of New York. G. Ross Henninger, assistant director of the Engi-

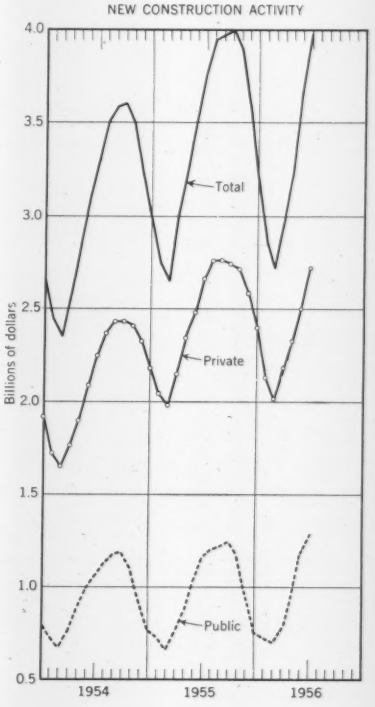
June Construction Activity Continues Seasonal Advance

The value of new construction put in place rose seasonally in June to $4 billion, slightly above the previous June record ($3.9 billion) set in 1955, according to preliminary estimates of the U. S. Departments of Labor and Commerce. For the first six months of this year, construction activity amounted to an all-time high of $20 billion, 2 percent above the figure reported for the first half of 1955. On a seasonally adjusted basis, outlays thus far in 1956 were at an annual rate of nearly $44 billion, compared with actual expenditures of $43 billion for the year 1955.

Virtually all types of construction shared in the 8 percent rise between May and June. Expenditures for new private industrial buildings, public utilities, and sewer and water facilities rose to all-time monthly highs. Outlays for highway construction, commercial building, and public educational building advanced to the highest June totals on record.

Private construction for June, at $2.7 billion, was slightly below the June 1955 total, mostly because spending for residential building, although above the May level, was off 12 percent from last June's extraordinary volume. However, public construction activity this June reached a new high for the month of $1.3 billion.

A shift occurred between 1955 and 1956 in the importance of several major types of construction under way during the first six months. Decreases in private house building and in public industrial construction were offset by increases in private industrial and commercial building, highway work, and public utility construction. Thus far in 1956, private outlays for new construction totaled $14.2 billion, showing a slight edge over the corresponding figure for 1955. Public construction expenditures, at $5.7 billion, were 4 percent higher this year than last, when the first six months are compared.



Record June construction, estimated at $4 billion, brings construction total for first six months of year to $20 billion.

neering Extension Service at Iowa State College, will be in charge of the project, which is aimed at identifying the industrial, technological, and educational trends influencing technical education.

New officers elected

William L. Everitt, dean of the College of Engineering at the University of Illinois and a distinguished electrical engineer, succeeds Dr. Boring as president of the ASEE. Cleo A. Brown, administrative assistant to the president of the General Motors Institute, Flint, Mich., was elected president of the society's instructional division activities. The new treasurer is John Gammell, director of graduate training at the Allis-Chalmers Manufacturing Co., Milwaukee.

ASEE honors went to Llewellyn M. K. Boelter, dean of the College of Engineering at the University of California, who received the Lamme Medal "for contributions to teaching, research, administration, and the advancement of the profession"; Clifford C. Furnas, chancellor of the University of Buffalo on leave while serving as Assistant Secretary of Defense for Research and Development, who received the Vincent Bendix Award for outstanding contributions to engineering college research; and Milton C. Shaw, professor of mechanical engineering at Massachusetts Institute of Technology, winner of the George Westinghouse Award for achievement in engineering teaching. Three young engineering teachers received special awards for papers on engineering education presented during the meeting. They were James T. Miller, of the University of Kentucky; Robert D. LaRue, of Colorado A. and M. College; and Herman L. Shulman, of Clarkson College of Technology.

Know Your Societies

The American Institute of Mining, Metallurgical and Petroleum Engineers (recently adopted new name for the American Institute of Mining and Metallurgical Engineers) has also adopted a new insignia. Like the new name of the 85-year-old organization, the new insignia recognizes the importance of oil-well drilling in modern mining operations by adding a representation of a drill derrick to the symbolic miners' tools.

Treatment Plant Awards for First Quarter of 1956

Construction contracts for 169 projects that will aid in stream pollution abatement were awarded by the municipalities of the nation during the first quarter of 1956. Of these contracts 73 were for new sewage treatment plants, and 96 for interceptor sewers, enlargements, and other related projects. Responsible for more than half the $129 million cost of the contracts was a large project for Allegheny County, Pennsylvania, which involved contracts totaling $78 million. The first-quarter summary is available from the U. S. Public Health Service, Washington 25, D.C.

Also available is a report of public sewage treatment plant construction for 1955. Identified as Public Health Service Publication No. 488, the bulletin is for sale by the U. S. Government Printing Office, Washington 25, D.C., at 15 cents a copy.

Expansion of Jidda Port Is Planned

The Department of Commerce calls attention to the fact that expansion of pier facilities in Jidda harbor to relieve present port congestion is under consideration by the Government of Saudi Arabia. While formal announcement of such a plan has not been made, qualified engineering firms may wish to send their representatives in the area to Jidda to study the project should an opportunity to bid occur. Further information may be obtained from the Government of Saudi Arabia, Jidda, Arabia.

New ARBA Road Show Planned for 1957

Another of the famous Road Shows staged periodically by the American Road Builders' Association is in the works. View at left harks back to the first Road Show, held in 1909 in Columbus, Ohio, where forty exhibitors displayed construction equipment. The 1948 Road Show, pictured at right, was largest outdoor exposition of construction machinery ever assembled to date. To encourage industrial attendance, the 1957 Road Show will be held off-season—January 28 through February 2—at the huge International Amphitheater in Chicago. Already more than 200 manufacturers have contracted for space at this show.

500 miles from anywhere

Here in a remote outpost in the Middle East, AERO engineers operate a Shoran station to help guide the AERO B-17 on a 200,000 sq. mi. natural resources survey. Tents, tower and two-man team were packed in by mules, along with rations and water. Emergency needs are supplied by air drop.

This assignment is typical of tough mapping jobs which AERO crews handle routinely in many parts of the world. Whether it's a resources inventory, exploration for oil or minerals, or mapping for highways, pipelines or other engineering development, AERO experience—over three million miles of it—and AERO manpower and facilities can pay off for you! Let our engineers meet with you.

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Oldest Flying Corporation in the World

Stainless Clad Steel Stands Up in Bridge Bearings

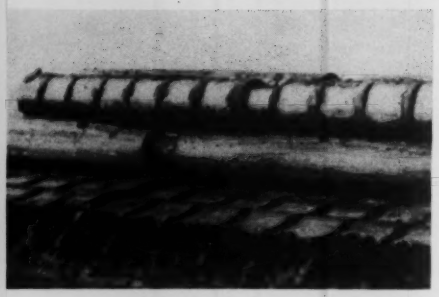
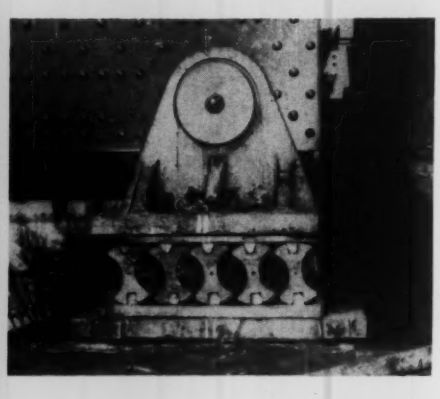


Photo above shows corroded carbon steel rollers and bearing plates removed from a railroad bridge when it became necessary to renew all roller-bearing assemblies because the corrosion froze the bearings and prevented any expansion. Photo below shows roller shoe assembly utilizing stainless steel rollers and bearing plates.



Bridge designers solve the problem of expansion and contraction movements by placing rollers or rockers and bearing plates at each end of the span. While this arrangement lets the structure change in length as the temperature changes, it creates in turn a new problem when the corrosion of carbon steel causes the rollers to freeze on the plates. When rollers are denied free movement along the bearing plates, the bridge and its supports are subjected to stresses, for which design provision has not been made. Further engineering problems arise—and heavy expenses ensue—when rollers and plates must be replaced under traffic.

Searching for a material to resist corrosion in these critical areas, Modjeski and Masters, consulting engineers of Harrisburg, Pa., first used heat-treated high chromium stainless steel instead of carbon steel for rollers and plates. The first known use of stainless steel for expansion rollers and plates was in connection with the Chain Bridge constructed over the Potomac River at Washington, D. C., about 18 years ago. Here the straight-sided segmental rollers were made of forged stainless steel, machined on all sides, and the bearing plates were of solid rolled stainless steel.

Some improvements have been made in design details tending to reduce the amounts of chromium nickel steels and the amount of machining necessary. A roller shoe assembly used for a recent railroad bridge is shown in one of the photos. The rollers, composed of cast stainless steel, are of the hour-glass or dumb-bell shape to conserve material and to facilitate cleaning of the assembly. They are individually positioned at each end by stainless steel pintles, machined like gear teeth, and inserted with a press fit into the top and bottom roller plates which are of solid rolled stainless steel. The ribs at the center of the rollers are designed to lock the rollers against each other before the expansion movement reaches the edge of the rolling surface. The bridge shoe casting and masonry plate are made of medium carbon steel.

Further study led the engineering firm to believe that stainless clad would do as effective a job at considerable saving in cost. However, a question arose from the nature of the duty the clad would be expected to perform. Stress analyses show that when a load-bearing roller is supported on a plate, a shearing action takes place with its maximum intensity at a depth dependent on the diameter of the roller. Since stainless clad steel consists of a layer of stainless bonded under heat and pressure to a carbon steel backing, it became necessary to determine whether the shear stress would affect the bond between the cladding and the parent metal.

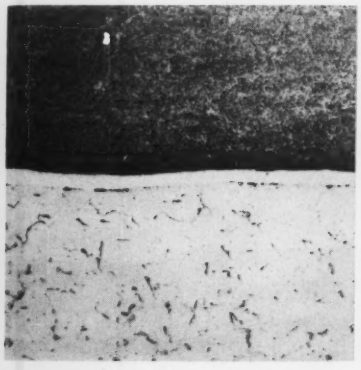
Application of the theory of elasticity showed that for a 10-in. roller under usual bridge-loading conditions, maximum shear stress occurred at a depth of 0.0075 in. It was further calculated that cladding should be at least 0.0625 in. thick to remove the bond line from the most highly stressed region.

Specimen bridge-bearing clad plates were then prepared by the Lukens Steel Company, Coatesville, Pa. Plates were fabricated in plain carbon steel as well as in 5 percent (0.0625 in.) and 10 percent (0.1250 in.) stainless clad of Types 316 and 410. Rollers were forged carbon steel and cast stainless. At the Sibley School of Mechanical Engineering, Cornell University, the specimens underwent an exhaustive testing program sponsored jointly by the Lukens Steel Company and Modjeski and Masters. The rollers and plates were later subjected to metallurgical examination at the Lukens Research Laboratory. A 100,000-lb-capacity screw-type universal testing machine provided a vertical load corresponding to the structural load on the rollers. The test set-up is shown.

The testing schedule called for all specimens to undergo at least 2,000,000 passes, equal to 50 years of actual service in a bridge. These tests and subsequent laboratory examination at Lukens disclosed the following results: (1) There was no damage to the bond between the stainless cladding and the carbon steel backing plates; (2) shear strength of the bonds was not lowered (rather there was a trend toward increased strength); and (3) hardness readings, made at $\frac{1}{4}$-in. intervals with a Rockwell tester and converted by chart to Brinell, show that the increase in hardness for all materials was insignificant.

Since the completion of this investigation, a number of new bridges have incorporated clad steel bearings. Among such installations is the $90,000,000 Walt Whitman Bridge across the Delaware River between Gloucester, N. J., and Philadelphia now under construction by the Delaware River Port Authority.

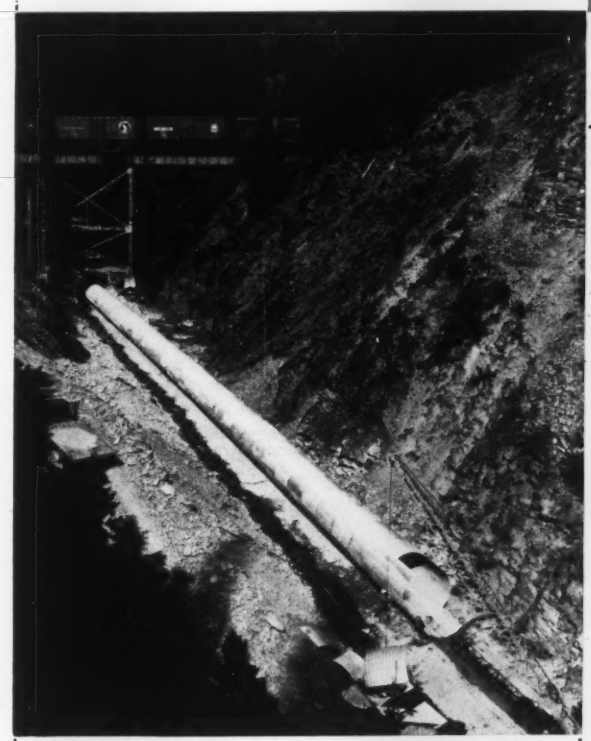
In left-hand view rocker is being tested in 100,000-lb-capacity screw-type universal testing machine. Upper testing plate was attached to the head of the testing machine by means of two self-leveling cylindrical surfaces. Lower plate was moved back and forth to simulate axial movement of the bridge structure, with a rack and gear actuating the roller and the upper testing plate. View at right shows bond line of specimen—$\frac{1}{8}$-in. Type 410 clad, $1\frac{1}{4}$-in. gage—at 60,000-psi load.



(Vol. p. 554)

Here's why Armco Drainage Structures will carry your HIGHEST FILLS

Two Armco MULTI-PLATE Pipes carry drainage through Ohio Turnpike's highest fill—108 ft. J. E. Greiner Co., Engineers; Howard, Needles, Tammen & Bergendoff, Contracting Engineers.



Fill height on this 102-inch structure will average 125 feet when completed. The installation is part of a realignment project on U. S. Route 2, Montana.

Modern highway construction calls for deep cut and high fill sections that were unheard of a few years ago. And the problem of drainage under these heavy fill loads is being solved more and more by durable Armco Corrugated Metal Structures. Here are some of the reasons why!

CORRUGATED METAL STRENGTH:
Armco Drainage Structures have the ability to flex under load and gain side support from the adjacent soil. The wide range of gages makes it easy to specify the strength you need.

STRONG JOINTS:
Bolted coupling bands make joints strong and tight. Soil movement or frost action won't disjoint the long pipe sections. Alignment stays good. With Armco MULTI-PLATE (large size structures that are assembled in the field from corrugated plates) the all-bolted construction makes one integral structure.

WITHSTANDS FOUNDATION SETTLEMENT:
With Armco Structures you can anticipate foundation settlement with a cambered design. The center portion is installed higher than the desired final flow line. As the foundation settles, the pipe adjusts to proper grade without affecting the joint strength.

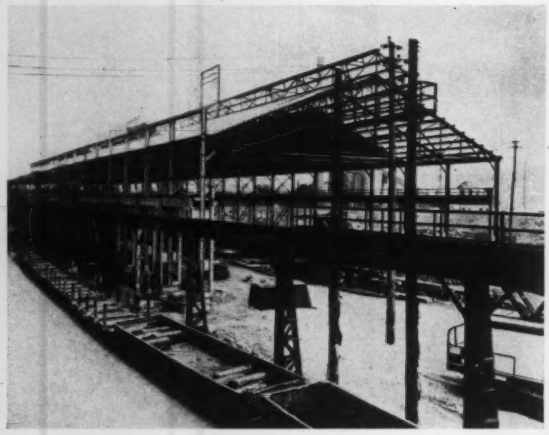
Write us for complete, authoritative data on Armco Corrugated Metal Drainage Structures. There is a size and type for almost any job. Armco Drainage & Metal Products, Inc., 3056 Curtis Street, Middletown, Ohio. Subsidiary of Armco Steel Corporation. In Canada: write Guelph, Ontario. Export: The Armco International Corporation.

ARMCO Drainage Structures

ARMCO®

Jones and Laughlin Builds New Aliquippa Works

This structure is part of a new 44-in. hot strip mill the Jones and Laughlin Corp. is building at its Aliquippa (Pa.) Works as part of a current $230,000,000 expansion and improvement program. The company's new program brings the amount it has spent on expansion since the war to over $750,000,000. It is planning early entry into a new field—production of stainless steel



R. ROBINSON ROWE, M. ASCE

"Well, Joe, what do your know about Io?"

"Gal or heifer," quipped Joe Kerr, "she got around. She was the Io in Ionian, the Jo in Jovian, and the Bos in Bosporus. Galileo called her Jupiter's No. I moon, so I'm not surprised that . . ."

"You're evading the real question," scolded the Professor. "As you very well know, I want to know how high is Io's Needle, computed from two sets of shadows from two moons. Do you or don't you know?"

"Yes, I was coming to that. I read all about Io trying to find the angle between Jupiter's two moons and found he had a harem of 11 going off in all directions. Then I got smart and graphed the problem (Fig. 1) with *A*, *B*, *C* and *D* located at shadow points measured from O at the base of the needle and *IO* representing the unknown height of Io. All I had to do was move *I* up and down until the angles *AIB* and *CID* were equal. This made Io 130 jovometers high."

"Once a draftsman, always a draftsman," sneered Cal Klater. "In Joe's figure, we can let *a*, *b*, *c* and *d* be the shadow lengths out to *A*, *B*, *C* and *D* and *h* be the unknown height *IO*. Then the angular distance between moons at the two different times can be expressed as the difference between two angles of right triangles and equated:

arctan a/h − arctan b/h = arctan d/h − arctan c/h which reduces to

$$h = \sqrt{\frac{ad(b-c) - bc(a-d)}{(a-d) - (b-c)}}$$

Then substituting $a = 114$, $b = 66$, $c = 55$ and $d = 99$, I found $h = 132$. I should add, however, that the equation presumes all points in the plane of the jovial equator and that parallax was negligible."

"The first presumption is the only explanation for the shadows being to the west at first and to the east later," agreed the Professor. "As for the parallax, the less said the better, which applies also to refraction and orbital motion of the moons and the question whether the cold slushy surface of Jupiter would support an obelisk at all.

"Actually this was a simplified version of the real problem, which I have reserved for a sequel. The Jovian surveyors were determining the height of Callisto's Needle, erected in memory of another favorite of Jupiter at some distance south of the equator. The first set of shadows, 66 and 114 jovometers long, ran south of west, due to the equatorial position of the two moons, and similarly, the second set, 55 and 99 jovometers long, ran south of east. Just before dawn, a third set measured 144 and 242 jovometers. Was Callisto higher than Io?"

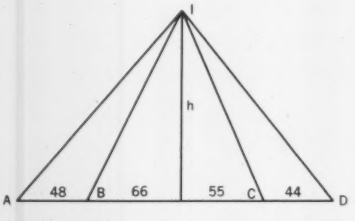


Fig. 1. With equal angles *AIB* and *CID*, *IO* had to be 132.

[Cal Klaters were Kum Pewter (Walter Steinbruch), S. K. Rueball (Keith Jones), Ed C. Holt Jr., Don'T (Donald P. Thayer), and Emerson J. Boyd Jr., who also solved the May pill-box problem.]

New Officers for ASME

William F. Ryan, vice-president, director and senior consulting engineer of the Stone & Webster Engineering Corp., Boston, has been nominated for 1956–1597 president of the American Society of Mechanical Engineers. He will be installed during the ASME's annual meeting in New York in November after letter ballot of the organization's membership.

The vice-presidential nominees are William H. Byrne, president and chairman of the board of Byrne Associates, Inc., New York; James H. Sams, dean of engineering at Clemson College; Rolland S. Stover, owner of R. S. Stover Co., Marshalltown, Iowa; and Clifford H. Shumaker, chairman of the department of industrial engineering at Southern Methodist University. Eugene W. Jacobson, of Pittsburgh, was nominated as technical director, and V. Weaver Smith, of New York City, as administrative director.

Earthquake Engineering Papers Are Available

Publication of the 34 technical papers presented at the World Conference on Earthquake Engineering, held at the University of California, Berkeley, this past June, is announced by the Earthquake Engineering Research Institute, sponsoring organization. There was a large representaton of engineers from abroad in the attendance of some 400, and the papers placed special emphasis on earthquake practices and problems in foreign countries. Engineers from Japan, New Zealand, Chile, Colombia, Mexico, Canada, Puerto Rico, Italy, Greece, Turkey, and French Morocco were heard from.

Copies of the published proceedings may be ordered from K. V. Steinbrugge, Secretary, Pacific Fire Rating Bureau, 465 California Street, San Francisco, Calif. The price is $8.50.

BIG NEWS in road maintenance:

COLD APPLIED

BITUMULS®

Slurry Seal

Spreader-box application of Bitumuls Slurry is fast and easy.

BITUMULS SLURRY SEAL is a fast, simple, and highly effective technique for getting extra years of satisfactory service out of cracked, worn, or spalled pavements.

The slurry, itself, consists of a mixture of Bitumuls emulsified asphalt and water to which sand or crusher dust (or a combination of both) is added to form a free flowing mix.

Typical Slurry Preparation

On a typical successful operation, the Bitumuls emulsion and water were first fed into the drum of a transit mix truck. Then aggregate, conforming to the following gradation, was added slowly to assure complete coating:

Sieve Sizes	*Per cent Passing*
Number 20	100
" 30	91
" 50	54
" 100	20
" 200	5

Method Of Application

The slurry, delivered to the job in the transit mixer, was chuted into a spreader box, towed behind the mixer truck, onto the pre-watered pavement. (The spreader box was a rectangular, sled-like frame, one traffic lane in width. It was equipped with a rubber strike off, or squeegee blade, which assured even distribution and uniform coating, and forced the slurry into cracks and depressions.)

Pioneered In The West

Quickly and easily applied at exceptionally low costs, Bitumuls slurry sets rapidly and can usually be opened to traffic within two to three hours.

This method was pioneered by Los Angeles County forces. Working closely with them were Engineers of American Bitumuls & Asphalt Company.

Bitumuls Slurry Seal has been used effectively in both Southern and Northern California, and test sections have been placed in other areas of the country. The "big news" of this relatively new method of extending pavement surface life is spreading fast. Get full data from our nearest office.

Aggregate and Bitumuls are fed into transit mix truck, then water is added as required.

Close-up view of the specially-designed spreader-box.

Leading Marketers of Asphalts, Cutbacks, and Emulsions — Nationwide.

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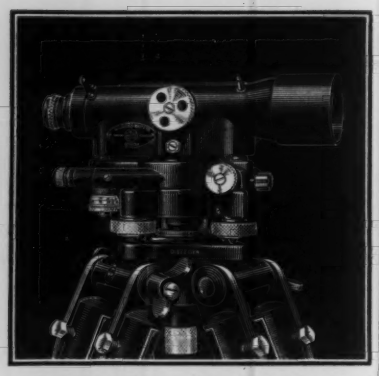
Portland 7, Ore. • Washington 5, D.C. • San Juan 23, P. R.



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Price $1.00

EZVC TABLES

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Atlanta, Ga.

News of Engineers

(*Continued from page 21*)

Earnest Boyce, chairman, department of civil engineering, University of Michigan, is the new president of The Engineering Society of Detroit. Professor Boyce was elected by the new Board of Directors at its organization meeting and assumed office July 1 for the fiscal year 1956–57.

Robert W. Schneider has been promoted by Infilco, Inc., from service engineer to field sales engineer for the Indiana, Michigan and Ohio area.

Carl W. Keuffel, president of the Keuffel & Esser Co., Hoboken, N.J., was recently honored with the 1956 citizen award of the New Jersey Society of Professional Engineers. The citation accompanying the award noted "his outstanding achievement in industrial statesmanship and the humanities and his everlasting endowment to public health safety and welfare."

Carl W. Keuffel

Russel S. Bodwell was recently appointed assistant chief engineer of the Union Building & Construction Corp. of Passaic, N.J. He was formerly associated with Porter, Urquhart, McCreary & O'Brien of Newark, N.J., as project manager on the New Jersey and Connecticut Turnpikes, and as soils and paving engineer on other turnpike projects.

Whitney K. Stearns has been appointed New England sales agent for the U. S. Pipe and Foundry Company of Birmingham, Ala. He has had several years of experience as a sales representative in the company's New York office.

Edmund Friedman has become a member of the newly-organized firm of Connell, Pierce, Garland and Friedman, Miami, Fla., specialists in coordinated architectural and engineering services for commercial, industrial, and institutional projects. Mr. Friedman continues his connection with the engineering firm of Connell and Associates, also of Miami.

Jack E. McKee, associate professor of sanitary engineering at California Institute of Technology, was recently promoted to professor. Formerly a partner in the consulting engineering firm of Camp, Dresser and McKee in Boston, Mass., Professor McKee joined the faculty of Caltech in 1949.

Theodore von Karman, Hon. M. ASCE, and chairman of the Scientific Advisory Board, U. S. Air Force, Washington, D.C., was honored recently by the Institute of Aeronautical Sciences at a dinner in Los Angeles, Calif. The Presidential Medal of Freedom, highest honor for a civilian, was presented to him for his theoretical work in aerodynamics. He is credited by aviation leaders with providing much of the foundation for modern aerodynamics.

Among five new members elected to the Board of Directors of Fay, Spofford, & Thorndike, Inc., Boston engineering firm, are **Burdette K. Beebe,** specialist in all areas of construction; **Fozi M. Cahaly,** whose specialty is water works and sewerage; **Edward C. Keane,** project engineer in charge of the Boston Artery design; and **Leon B. Turner,** well known for his work on express highways and military bases.

Samuel R. Young is retiring after 40 years of service with the Atlanta and West Point Rail Road Co. and the Western Railway of Alabama. Mr. Young entered the services of the railroads in May, 1916, as assistant engineer. Subsequently he served as division engineer, chief engineer, assistant general manager, and (since 1947) as president and general manager. He will continue to serve as director of the two lines.

Cedric L. Dayton has joined the staff of Seelye Stevenson Value & Knecht of New York. He was formerly with Walsh-Fuller-Slattery on the New York Coliseum, and before that, with Ford, Bacon and Davis, Inc.

Joseph W. Gunther and **Bruce F. Miller** recently joined the staff of Midwest Research Institute at Kansas City, Mo. Mr. Gunther previously was a design engineer for two Kansas City firms, and after 1952 headed his own engineering organization. Mr. Miller has had industrial experience with three Kansas City firms, the Municipal Service Co., the Marly Co., and the Temperature Engineering Corp.

John J. White, principal associate and chief specification engineer of Parsons, Brinckerhoff, Hall and Macdonald of New York, was one of five alumni of New York University honored at the 124th annual commencement. A bronze medallion was awarded to Mr. White for meritorious service rendered to the University.

John J. White

Theodore W. Van Zelst, president of Soiltest, Inc., Chicago manufacturer of engineering test apparatus for soils, concrete and asphalt, has recently returned from a trip to South America where he visited his firm's sales representatives. While in Bogota, Colombia, he attended the opening of the new Ministry of Public Works Laboratory and presented a two-day course in field and laboratory testing to 75 Colombian engineers.

DECEASED

Helmer Edward Brockhoff (A.M. '44), age 43, structural and mechanical engineer with the Commonwealth Electric Company of St. Paul, Minn., died at his home in Minneapolis recently. A graduate of the University of Minnesota, class of 1933, Mr. Brockhoff began his career with the Power Service Corporation of Minneapolis the following year. He was appointed assistant chief engineer in 1940 and was concerned with preparing estimates for the construction of power and industrial plants and with their subsequent management. In 1947 he entered the service of the Commonwealth Electric Company.

Roger Deland French (M. '22), age 71, retired professor of highway and municipal engineering at McGill University, Montreal, Canada, died at his home there recently. A graduate of Worcester Polytechnic Institute, class of 1905, he received his civil engineering degree there in 1908. Mr. French worked in various capacities in the engineering field for several years and in 1911 joined R. S. & W. S. Lea, consulting engineering firm of Montreal, as principal assistant engineer. He was a specialist in the field of municipal and highway engineering. From 1910 to 1920 he lectured at McGill University and in 1920 became professor of highway and municipal engineering, retiring in 1952. The author of numerous papers in various technical journals, Professor French was awarded the Gzowski Medal by the Engineering Institute of Canada.

Howard A. Gray (M. '22), age 67, for the past twenty years with the Boston firm of Jackson and Moreland, died recently at his home at West Somerville, Mass. An engineering graduate of Tufts College in 1911, Mr. Gray received an L.L.B. from Northeastern University in 1915 and was a member of the Massachusetts Bar. He had been with the Edison Electric Company, Stone and Webster, and Fay, Spofford & Thorndike, of Boston, and for ten years was in charge of the engineering department for the Morton C. Tuttle Company, of Boston. He had also been supervising engineer on design and construction of the Boston, Detroit, and Philadelphia plants of the U. S. Gypsum Co. Mr. Gray was the author of many technical papers on moisture penetration, and had taught evening courses at Northeastern University, the Boston Architectural Club and Franklin Union.

Samuel C. Hadden (M. '43), age 73, former chairman of the Indiana State Highway Commission died on May 9 at his home in Indianapolis, Ind. He was chairman of the Commission for two four-year periods, from 1940 to 1944 and

(*Continued on page 92*)

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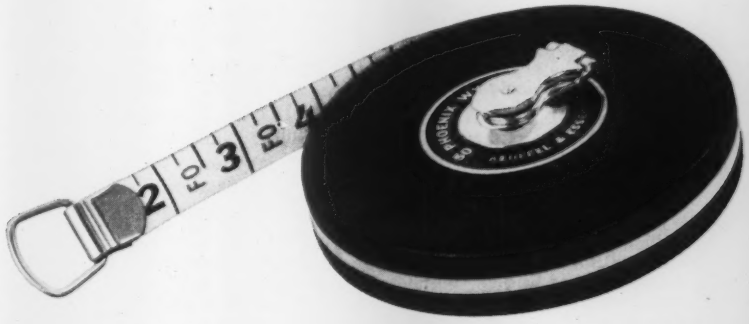

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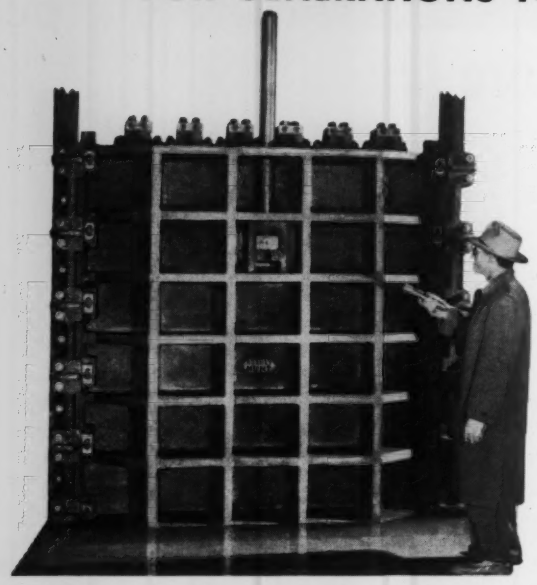

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(*Continued from page 91*)

again from 1948 to 1952, after which he became consultant for the Chicago Motor Club. A graduate of the University of Illinois in 1905, Mr. Hadden became an instructor at Michigan Agricultural College for four years, editor and part owner of several engineering magazines for eighteen years, and became associated with the State Highway Department in 1941. He received many honors for his work in highway research and improvement and was the recipient of the 1953 George S. Bartlett award, presented to the man who contributed most to highway progress.

John Patrick Henry Hallahan (A.M. '20), age 73, president and treasurer of John P. Hallahan, Inc., Philadelphia, Pa., died at his home in Lansdowne, recently. Early in his career Mr. Hallahan was associated with the Filbert Paving & Construction Co. of Philadelphia as general superintendent of all construction work including the building of the concrete bridge over the New York Division of the Pennsylvania Railroad. In this same type work, he participated in the building of many office buildings, factories, and garages throughout Pennsylvania and New Jersey. From 1914 to 1918 he was with Cramp & Company of Philadelphia as superintendent on construction of buildings including the Traymore Hotel, at Atlantic City, N.J., leaving to join the George F. Pawling & Co., engineers and contractors of Philadelphia, as director in complete charge of building. He formed his own company in 1921, which in 1926 became the John P. H. Hallahan Company.

Carl August Hoglund (A.M. '12), age 75, retired principal engineer, Inventory and Pricing Branch, Bureau of Valuation, Interstate Commerce Commission, Washington, D.C., died at his home in Fort Lauderdale, Fla., recently. Mr. Hoglund had been with the Bureau for more than twenty-five years holding various positions—engineer, senior engineer, and principal engineer. He retired in 1947. Early in his career Mr. Hoglund was associated with Chicago, Burlington & Quincy Railroad as assistant engineer on track elevation in Chicago, the Chicago Belt Railroad, and the Chicago and Western Indiana Railroad in charge of railway elevation. From 1913 until he joined the Bureau in 1922, Mr. Hoglund was in private practice.

Richard Haden Hood (M. '98), age 88, retired civil engineer of Los Angeles, Calif., died there recently. A graduate of Rensselaer Polytechnic Institute, class of 1887, Mr. Hood's early career was spent with the Georgia, Carolina & Northern Railroad in Greenwood, S.C., as bridge engineer, and as chief engineer with the Seaboard Air Line of Raleigh, N.C. He also was a professor of civil engineering at the University of Missouri in Columbia,

Mo. From 1893 until his retirement in 1921, Mr. Hood was in private practice in New York City as an engineer for steel and timber structures and engaged in general contracting for their construction.

Howard Sanford Hougland (M. '44), age 57, contracting engineer with the Bethlehem Steel Company of New York City, died here on May 27. Mr. Hougland graduated from Iowa State College in 1923 and that same year joined Bethlehem Steel and its predecessor McClintic-Marshall Co. He was in charge of the engineering and estimating departments making quantity and cost estimates for steel structures and supervising structural designs. He had charge of dismantling several steel-frame mill buildings, refabricating the steel and reerecting it into buildings at new locations. Projects he worked on included the Cathedral of Learning at Pittsburgh, Pa., Newark Station and Lift Bridge, Pennsylvania Railroad and the Bronx, N.Y., County Court House.

Morris M. Kaminsky (M. '41), age 55, consulting engineer of Marion, Ind., died there recently. A specialist in bridge, steel and concrete structures, Mr. Kaminsky had been associated with the W. J. Holliday Co., fabricators of reinforcing bars, in Hammond, Ind., as chief engineer for 16 years before going into private practice in 1941. A graduate of Purdue University, class of 1926, he received his civil engineering degree there in 1930.

Ernest William McMullen (A.M. '21), age 67, partner in the firm of Ganteaume & McMullen, engineers and architects of Boston, Mass., died at his home in Waban, Mass., recently. He had been associated with Mr. Ganteaume since 1937 and prior to that was executive engineer with Monks & Johnson, architects and engineers of Boston, for 24 years. During World War I he organized and had complete responsible charge of a large drafting organization that designed such structures as the Destroyer Plant at Squantum, Mass.; development and construction of shipways at Sparrows Point, Md.; Liberty Shipbuilding Yard at Wilmington, N.C., and Alameda Plant of Bethlehem Shipbuilding Corporation. Mr. McMullen was chief of the Northeast Division of the Corps of Engineers for two years during World War II.

Clifford C. Muhs (M. '25), age 70, retired consulting engineer and specialist in subaqueous construction and reinforced concrete foundations, died at his home in Chicago on June 20. A graduate of Cornell University, class of 1905, Mr. Muhs located the first railway over the Andes Mountains. He was head of Muhs & Company of Chicago, negotiating loans and construction contracts with foreign countries for public improvements on highways, harbors, river improvements, and consultant for H. M. Byllesby & Co. and George M. Forman & Co. of Chicago on utilities, buildings, and industrials.

(*Continued on page 94*)

Dredge Franciscan is 207′ long, digs 50′ deep, with ladder at 45°, pivots in 350′ arc on one of two 80′ spuds, has seagoing stern. Present power comes from shore, but design provides for installation of on-board power plant.

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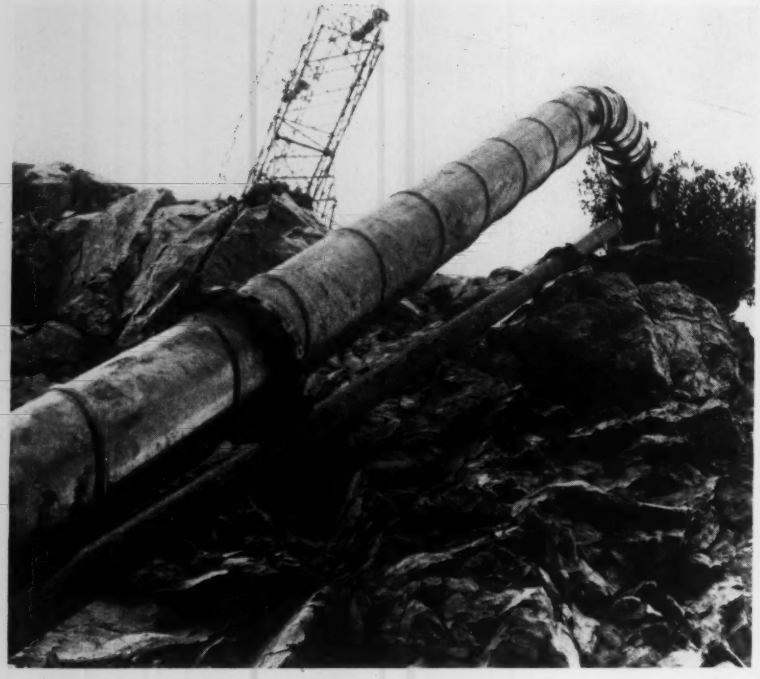

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(*Continued from page 92*)

He was also engineer in charge of construction on such projects as Wacker Drive in Chicago for the Board of Local Improvements, and supervised bridge and road buildings in South America and Korea.

William H. Nalder (M. '28), age 71, former chief designing engineer of the Bureau of Reclamation and one of the nation's leading authorities on the design of irrigation and power structures, died at his home in Denver, Colo., on May 31. Mr. Nalder began a 43-year career in the Bureau of Reclamation following his graduation from Washington State College as a civil engineer in 1909. After three years on the Yakima Project and five years on the Sun River Project he was transferred in 1917 to the Bureau's offices in Denver as a designer. There he assisted in the design of Hoover, Grand Coulee, Shasta, and numerous other dams and irrigation systems. Mr. Nalder was named assistant chief engineer in 1945 and chief designing engineer in 1949. He retired in 1952 due to ill health. Mr. Nalder, in 1949, served as a staff adviser on irrigation to the U.N. Economic Survey Mission for the Middle East.

W. H. Nalder

Samuel Napp (M. '48), age 73, consulting engineer of New York City, died at his home here recently. A graduate of the University of Pennsylvania, class of 1913, he received his civil engineering degree there in 1926. Mr. Napp was structural engineer and designer in charge with John T. Windrin, architect of Philadelphia, for many years and was instrumental in the designing and building of several power plants and office buildings for the Bell Telephone Co. in Pittsburgh. From 1917 to 1919 he was reinforced concrete designer for the U. S. Government on the concrete pier at Cristobal, Canal Zone. He had been in private practice in Philadelphia and New York City since 1926.

William Welcome Peabody (M. '09), age 87, retired civil engineer of Holden, Mass., died at his home there recently. A student of civil engineering at Massachusetts Institute of Technology, Mr. Peabody held various positions in the engineering field in and around the Boston area from 1891 to 1903. Soon after, he joined the Board of Water Supply of New York City as assistant engineer and later was appointed division engineer. In 1916 he became deputy chief engineer of the Providence Water Supply Board at Providence, R.I., leaving in 1930 to become division engineer of the Metropolitan District of the Water Supply Commission at Holden, Mass. He retired in 1950.

Langdon Pearse (M. '13) age 79, sanitary engineer of the Metropolitan Sanitary District of Chicago, Ill., died suddenly at his

(*Continued on page 96*)

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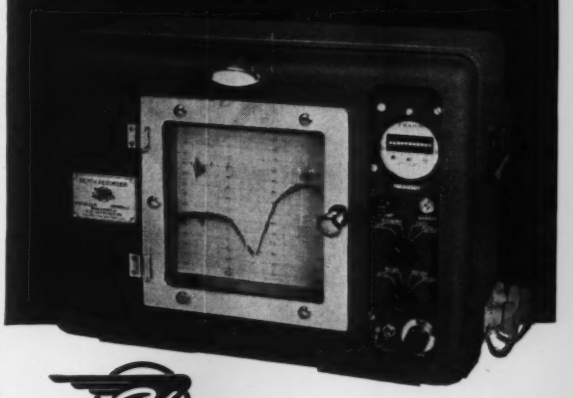

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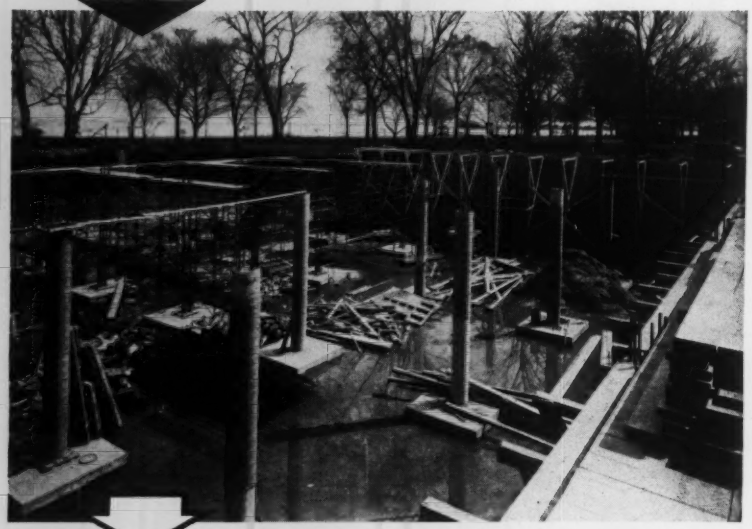

Water Supply Plant, Wyandotte, Mich. Pate and Hirn, Architects and Engineers. Edward Schendel, Contractor. Photo by Win Brunner.

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(Continued from page 94)

home in Winnetka, Ill., on July 19. Mr. Pearse, one of the country's outstanding specialists in the sanitary field, has been connected with the Sanitary District of Chicago since 1909. He has played an important role in the District's vast system of treatment and disposal works, as well as in its experimental work on the treatment of domestic and industrial wastes. As an expert witness, he has appeared not only for the Sanitary District of Chicago in lake-level and other litigation, but also for the State of Illinois on the Upper Illinois River, and for the State of New Jersey on the taking of Delaware River water by New York. A graduate of Harvard College (1899), he received his civil engineering and master's degree from Massachusetts Institute of Technology in 1902. He is the author of many papers published in the technical press dealing with his specialty. For many years a member of the Sanitary Engineering Division's Committee on Sewerage and Sewerage Treatment, he was chairman for four years.

Charles U. Powell (M. '17), age 79, for fifteen years chief engineer of the Queens Topographical Bureau, died at his home in Flushing, N.Y., recently. He was a graduate of Cornell University, class of 1898. From 1902 to 1930 Mr. Powell was employed by New York City on subway construction, and later became engineer in charge of planning for the Borough of Queens. He was largely responsible for the present system of house numbers and street names for the borough, which differs from the systems in use in the other New York boroughs. Named chief of the Queens Topographical Bureau in 1915, he laid out 2,500 miles of streets, and planned the public ocean beach at Rockaway and Queens Park. Beginning in 1920, Mr. Powell was also consulting engineer to the Queens Planning Commission, which directed the layout of the state parkway system through the borough. He retired in 1942.

Homer R. Seely (M. '34), age 59, civil engineer and former Deputy Commissioner of the New York City Department of Public Works, died at his home in Woodbury, N.J., on June 23. A graduate of Cornell University, class of 1919, Mr. Seely was employed for four years by the Bethlehem Steel Company, engaged in the construction of the Delaware River Bridge from 1923 to 1925, and until 1934 was associated with the Port of New York Authority on preliminary design studies for the George Washington Bridge and miscellaneous work on the Arthur Kill Bridges. He was resident engineer on the Triborough Bridge for three years and from 1938 to 1947 he served as Deputy Commissioner of the Department of Public Works of New York City in charge of bridges. For the past four years he was associated with Modjeski & Masters-Ammann & Whitney of Camden, N.J., and New York, having recently served as project engineer on the Walt Whitman Bridge between Philadelphia and Glou-

(Continued on page 98)

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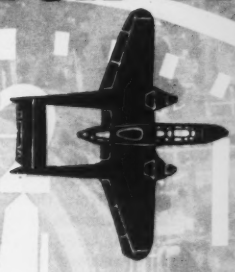

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(*Continued from page 96*)

cester. Mr. Seely was director of the Metropolitan Section of ASCE and had contributed a great many papers to ASCE technical publications and CIVIL ENGINEERING. He was a recipient of the ASCE James Laurie Prize in 1934.

Simon W. Tarr (M. '16), age 82, former chief mechanical engineer for the Oliver Iron Mining Division of U. S. Steel Corp., Duluth, Minn., died there recently. A graduate of Iowa State College with a civil engineering degree, he joined the Oliver staff in 1902 at Duluth, heading the mechanical engineering division when he retired in 1941. A past-president of the Duluth branch of ASCE, Mr. Tarr was vice-president of St. Luke's Hospital there and played a major part in the planning of the hospital's extensive construction program.

Franklin Pierce Turner (M. '23), age 81, retired principal assistant engineer with the N. & W. Railroad of Roanoke, Va., died at his home there recently. Mr. Turner joined N. & W. in 1901, holding various positions including engineer-in-charge of construction of important bridges; deep water foundations; 60 miles of track in Ohio; and rebuilding of the Ohio River Bridge, at Kenova, W. Va. He was bridge engineer for ten years and held the position of principal assistant engineer until his retirement in 1947. Mr. Turner was graduated from Virginia Polytechnic Institute in 1896 and for two years was a postgraduate student and instructor in civil and bridge engineering courses there. For many years he was contact member of the Student Chapter at V.P.I.

Donald Cramer Waite (M. '20), age 73, assistant division engineer, IRT Division, New York City Transit System, died in Rochester, N.Y., recently. Mr. Waite, a specialist in railroads, began his career in 1904 on maintenance and construction of subway and elevated divisions of the Interborough Rapid Transit Co. of New York City. He held the positions of assistant engineer, road engineer, engineer of maintenance of way, and since 1940 assistant division engineer. A graduate of the University of Michigan, Mr. Waite received his degree in civil engineering in 1904.

Ray Warren (M. '48), age 59, executive director of Greensboro Public Housing Authority, Greensboro, N.C., died there on May 23. A graduate of the United States Military Academy at West Point, N.Y., class of 1920, Mr. Warren began his career working for the city of Washington, N.C., first as engineer inspector and later as assistant city engineer. In 1922 he joined the staff of the city of Greensboro, N.C., as assistant engineer. During his 34 years of service with the city of Greensboro, he held the positions of highway engineer; director of the Department of Public Works; city engineer; chief building inspector; and most recently as director of the Housing Authority.

Moultrie Alfred Warren (A.M. '47), age 43, engineer-in-charge of the Savannah, Ga., field office of the U. S. Geological Survey and an authority on the underground water supply of the coastal section, met with a tragic death in the field office on April 30. A graduate of Georgia School of Technology, class 1937, he had been with the Geological Survey since 1938 as junior hydraulics engineer, assistant hydraulics engineer, and after 1943 as associate hydraulics engineer. He served for two years during World War II as lieutenant in the U. S. Navy. Mr. Warren received a master's degree in hydraulics from the University of Iowa in 1947. He was Chief of the U. S. G. S. Office in Santa Barbara, Calif., for two years, and in 1950 was sent to Brookhaven National Laboratory in Upton, N.Y., to do research on atomic problems connected with ground water.

Noble Earl Whitford (A.M. '05), age 91, retired civil engineer of Richmond, Va., died at his home there on May 7. Mr. Whitford graduated from Syracuse University in 1889 and shortly thereafter went to work for the State Engineers Department of New York State. While with the office of the New York State Engineer, he helped to develop the state's highway and canal systems and the Syracuse water works system. He retired as senior assistant engineer in 1928 to go into private practice. Mr. Whitford was the author of several books on canal systems in New York State and other parts of the world.

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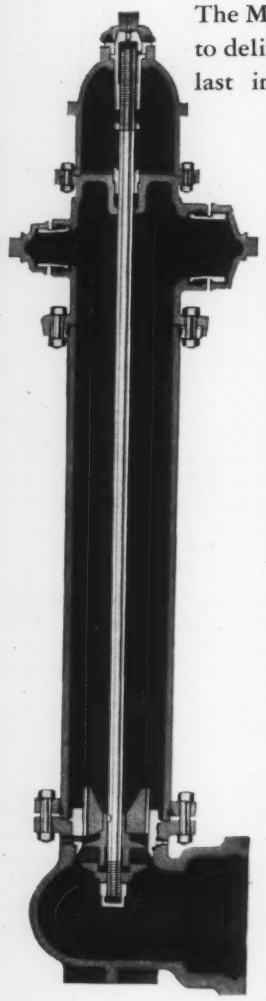

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Non-ASCE Meetings

Seventh Alaskan Science Conference. Sponsored jointly by the Alaska Division of the American Association for the Advancement of Science, American Society of Civil Engineers and the Alaska Chapter of the Society of American Foresters at Juneau, Alaska, September 27–30. Information from C. Howard Baltzo, General Chairman, Seventh Alaskan Science Conference, Fish and Wildlife Service, Juneau, Alaska.

American Society for Testing Materials. Second Pacific Area National Meeting at the Hotel Statler, Los Angeles, Calif., September 16–22. Information from ASTM, 1916 Race Street, Philadelphia 3, Pa.

American Public Works Association. 1956 Public Works Congress & Equipment Show at the Will Rogers Memorial Auditorium and Coliseum and Exhibit Building, Fort Worth, Tex., September 23–26. Information from APWA, 1313 East 60th Street, Chicago 37, Ill.

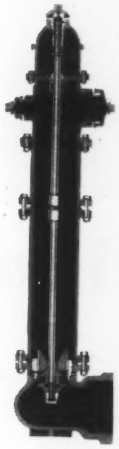
Annual International Instrument-Automation Conference & Exhibit. Will be held in New York, N.Y., September 17–21. For information, write Fred J. Tabery, 250 W. 57th Street, New York, N. Y.

Atomic Industrial Forum. Annual meeting at the Morrison Hotel, Chicago, Ill., September 25–27. Information from AIFI, 260 Madison Ave., New York 16, N.Y.

Building Research Institute. BRI Modern Masonry Conference sponsored by the Allied Masonry Council will be held in Washington, D. C., September 19–20. Information from C. E. Silling, Chairman, C. E. Silling & Associates, Charleston, W.Va.

Producers' Council, Inc. The 35th Annual Fall Meeting and Chapter Presidents' Conference at the Wade Manor Hotel, Cleveland, Ohio, September 25–26. Information from the Producers' Council, Inc., 2039 K. Street, Northwest, Washington 6, D.C.

Time and Money Flange Barrel Hydrant



Breakable Flange and Stem Coupling

Optional feature furnished at extra cost. Specially designed flange in the standpipe just above ground level and a frangible coupling in the hydrant stem are designed to snap when struck a blow heavy enough to break the hydrant. Both can be replaced quickly *and without excavating*, while hydrant head, standpipe and stem remain undamaged.

ADDITIONAL ADVANTAGES

Two-way heads can be replaced with steamer and two-way heads without shutting off water.

Shield operating nut assures protection for the revolving nut from sleet, snow or dust.

An extension piece may be inserted between hydrant head and barrel or between barrel and elbow.

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New in Education

New Courses. A new four-year curriculum in fire protection leading to a degree of bachelor of science will be offered at the University of Maryland College of Engineering. The program has been planned for students desiring careers in fire protection and prevention. The first two years of the curriculum will be practically identical with the freshman and sophmore years in the College of Engineering and entrance requirements are the same as for that college. . . . . A new five-year cooperative program designed to increase the output of engineers has been arranged by Western Maryland College and the University of Maryland College of Engineering. Under this program a student can attend Western Maryland College for three years followed by a two-year program at the University of Maryland. Graduates of this five-year plan will receive both an arts degree from WMC, and an engineering degree from the university. . . . . A broad program in applied meterology that touches upon a wide range of activities in many fields is being introduced in the University of Michigan's College of Engineering. The program is offered through the Department of Civil Engineering, and deals with meterology as it applies to engineering, architecture, conservation, and a host of other areas. Typical of the broad research projects under way or projected is a five year study of air pollution under the auspices of the National Institute of Health. Requests for further information should be addressed to E. Wendell Hewson, Professor of Meteorology, University of Michigan, Ann Arbor.

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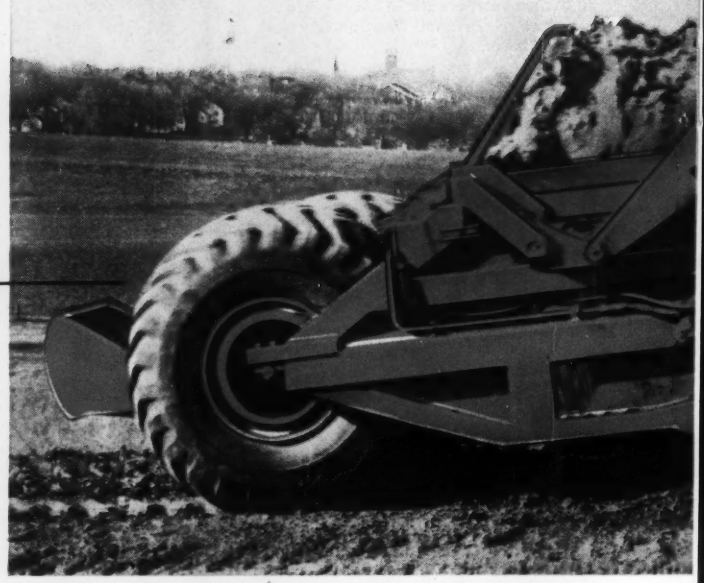
14 YD (HEAPED)



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Power-Matched for Speed

With plenty of engine power, the TS-260 loads fast, hauls fast, dumps fast . . . moves big payloads at low cost, even under tough conditions.

Power-Matched to Strength

The TS-260 has the structural strength and balance to effectively utilize all of its horsepower . . . with extra capacity built into the clutch, transmission, final drives and drive axles . . . and with a heavy, all-steel, box-type tractor frame.

Power-Matched for Operating Ease

Overlapping gear speeds in all four gear ratios reduce gear shifting, speed work cycles. And with 90-degree steering for rapid maneuvering in close quarters, it's easy for the operator to get the most out of the TS-260.

Motor Scraper

"Live-action" hydraulics for sure control. Positive gear-driven pump provides constant power for both steering and scraper operation.

Positive 90-degree steering for close-quarter maneuverability. A 30-degree turn of steering wheel directs full pump flow to two double-acting steering jacks for fast, positive turns up to 90 degrees. For slow turns, a slight turn of the steering wheel provides smooth response.

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Heavy-duty power train. The TS-260 power train transmits high engine torque to the drive wheels with maximum efficiency. The engine, clutch and constant-mesh transmission are assembled as a unit to assure accurate alignment. Simplified removal of each individual component provides easy serviceability.

Double-safety brakes for positive stops.

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RECENT BOOKS

Analysis of Structures: The Analysis of Statically-Indeterminate Structures by the Deformation Method

As stated in the preface, the main purpose of this book by M. Smolira is to give in convenient form time-saving methods of analyzing continuous frames with curved members, and Vierendeel trusses both continuous and simply supported. An introductory chapter deals with rapid methods of analysis of continuous beams and frames with straight members. Numerical examples are given to illustrate the theory. (Concrete Publications, Ltd., London, 1955. 173 pp. 18s.)

Design of Reinforced Concrete

The theory and methods of design of individual, unconnected members are presented in detail and, in the last chapter, are combined and applied to the design of a number of the components of the frame of a three-story industrial building. Special features include formulas for designing slabs and beams which automatically include their own weight; empirical formulas for estimating size and weight of footings; formulas for estimating cross sectional dimensions of prestressed beams; a method of designing eccentrically loaded cracked columns; and the method of two-cycle moment distribution. The book is intended both as a text for students and as a guide for practicing engineers. The author is Boris W. Boguslavsky. (The MacMillan Company, 60 Fifth Avenue, New York 11, N.Y. 428 pp., bound. $7.50.)

Eigenschaften und Wirkung Luftporenbildender—Zusatzmittel bei der Verwendung zu Beton

A review, by Kurt Walz of the properties and effect of air-entraining agents when used in concrete. Part I is a paper on the present state of research and practice in this field, and Part II is an annotated bibliography of 212 references on the subject covering the period 1944–1954—more than half of them to English language articles. (Deutscher Ausschuss für Stahlbeton, number 123, Wilhelm Ernst & Sohn, Berlin. 43 pp., DM 9.00.)

Applied Structural Design of Buildings

This practical handbook by Thomas H. McKaig for structural and plant engineers, architects, draftsmen, and license applicants contains a wide range of formulas, tables, and typical computations for the design of steel, concrete, and wood structures. The eleven sections of the book contain data and calculations covering properties of materials, properties of sections, beam and column design, connections, wind stresses, shallow bins and bunkers, etc. Design procedures are based on the various standard codes. (Second Edition. F. W. Dodge Corporation, 119 W. 40th Street, New York 18, N.Y. 442 pp., 1956. bound, $12.50.)

Architectural Construction

This volume by Theodore Crane surveys all the better types of construction in use in the United States today and presents a procedure for determining the type of frame, foundation, floor, roof, and wall construction most suitable for any particular structure. The first chapter discusses published building codes and design standards, and a separate chapter on wide-span designs is included. The book is intended for practicing architects and architectural engineers as well as students, and should be of value to mechanical and electrical engineers who need a knowledge of modern building assemblies. (John Wiley and Sons, Inc., 440 Fourth Ave., New York 16, N.Y. Second Edition, 1956. 433 pp. bound. $10.00.)

Strength of Materials

Part II. Advanced Theory and Problems

The second volume of the revised edition of this standard work for graduate students, designers, and research engineers includes a considerable amount of new material. Major changes have been made in the chapters devoted to torsion, plastic deformation, and the mechanical properties of materials. In the latter chapter, information for the proper selection of working stresses has been presented in considerable detail. New references, figures, and problems have been inserted throughout the text. The author is S. Timoshenko. (Third edition, D. Van Nostrand Company, Inc., Princeton, N.J. 572 pp., bound, $7.50.)

The College Blue Book

A standard work of reference of higher education in the United States, this eighth edition (1956) replaces the seventh edition printed in 1953. The volume is a gold mine of information about every institution of higher learning requiring graduation from a secondary school for admission. It includes a section on engineering schools by W. Leighton Collins, Secretary ASEE, and lists the engineering curricula accredited by ECPD. Other sections of particular interest to engineers are devoted to technical institutions and to scholarships, foundations and research. (Christian E. Burckel, Editor and Publisher, P. O. Box 311, Yonkers-on-Hudson, N.Y. 688 pp., $12.)

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Legal Cases for Contractors, Architects, and Engineers

The author, I. Vernon Werbin, a licensed professional engineer as well as a practicing attorney, discusses fifty-two situations which have actually arisen out of construction contracts. Among the problems covered are contracts required to be in writing; liability for defective work; damages resulting from erroneous location of work by an engineer; damages recoverable by owner for defective construction; and so on. Each discussion is accompanied by citations of appropriate cases. (McGraw-Hill Book Company, Inc., 330 West 42nd Street, New York 36, 1955. 487 pp., bound, $6.00.)

Modern Techniques of Excavation

Land clearing, ditching dewatering, landscaping, grading, tunneling, underground mining, and other operations are described in detail by Herbert L. Nichols, Jr., with special attention given to planning, supervision, and techniques for solving problems that may arise. With the exception of a section on defects in equipment, the contents follow closely the chapters titled "The Work" in the author's "Moving the Earth," published in 1955. (North Castle Books, Greenwich, Conn., 1956. Various pagings, bound. $9.00.)

Mathematics Refresher for Professional Engineers' and Land Surveyors' License

John D. Constance is the author of a collection of problems, with solutions, explanations, and illustrative diagrams, based on examinations given in a number of states. The problems cover the subject from algebra through calculus and are supplemented by a number of pages of reference data. (John D. Constance, 625 Hudson Terrace, Cliffside Park, N.J. 1956, various paging. Paper $2.00.)

Substructure Analysis and Design

Emphasizing solutions to the problems of the design engineer, this text covers methods of evaluating lateral earth pressures; applications of these methods to the design of flexible bulkheads; allowable soil bearing pressures; footing design; and piles and groups of piles. The last seven of the thirteen chapters in the book are devoted to the specialized phases of substructure analysis relating to the design of cofferdams, caissons, breakwaters, and piers. A considerable amount of new design information is included in this edition. Paul Andersen is the author. (Second edition, 1956, The Ronald Press Company, 15 East 26th Street, New York 10, N.Y. 336 pp., bound, $7.00.)

Stabilite des Terres

This treatise by Jacques Verdeyen and Victor Roison deals with the physical characteristics of earth as a construction material, not with the mechanics of soil "in place." The first section presents fundamentals and a detailed treatment of the utilization of earth in highway construction with special attention to stabilization and compaction. The second section covers stability problems in retaining walls, sheet piling, etc. The third analyzes the stability of earth slopes and the effect of the percolation of water through them. (Editions Eyrolles, Paris. 1955. 420 pp., Frs. 3950.)

The Steel Skeleton: Volume II. Plastic Behaviour and Design

The first volume of this work was a report of investigations made on the elastic behavior of steel structures. In this volume detailed accounts are given of tests and theoretical studies on rigid frames, beams, and columns, made in order to develop a simplified method for the design of steel structures, based on their plastic behavior. A proposed design method for multi-story frames is presented, and some actual applications of the method are briefly described. Authors are J. F. Baker, M. R. Horne and J. Heyman. (Cambridge University Press, Cambridge, Mass. 1956, 408 pp. Bound $12.00.)

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New Publications

Beach erosion . . . Availability of four recent studies of beach erosion and allied problems is announced by the Beach Erosion Board. The new Technical Memoranda are identified as No. 65, "Sand Variation at Point Reyes Beach, California"; No. 66, "Factors Affecting the Economic Life of Timber in Coastal Structures"; No. 67, "A model Study of the Run-up of Wind-Generated Waves on Levees with Slopes of 1:3 and 1:6"; and No. 68, "Wave Action and Sand Movement near Anaheim Bay, California." Inquiries should be sent to the Beach Erosion Board, Office of the Chief of Engineers, Washington, D.C.

Atomic energy . . . In "Selected Readings on Atomic Energy," the U. S. Atomic Energy Commission has compiled a helpful bibliography of references in the field. The 50-page reference is for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C., at 25 cents a copy.

Concrete pavement performance . . . Factors affecting pavement performance are discussed in Bulletin 116 of the Highway Research Board, entitled "Experimental Concrete Pavements." The bulletin contains investigations of projects in Indiana and Ohio to determine the relative performance of various thicknesses of sub-bases under portland-cement-concrete pavement. It is priced at $1.35, and may be purchased from the Highway Research Board, 2101 Constitution Avenue, Washington, D.C.

Nuclear research . . . The sixth in a series of unclassified Annual Reports gives an account of the progress of the Brookhaven National Laboratory during the fiscal year ending June 30, 1955, and its plans for the future. The Laboratory is operated for nuclear research by Associated Universities, Inc., under contract with the Atomic Energy Commission. Copies are available from the Office of Technical Services, U. S. Department of Commerce, Washington 25, D.C., at 75 cents each.

Nail popping . . . Since nail popping (i.e., the emergence of nail heads) is likely to reduce the value of finished structures, the problem has been the subject of extensive study. A recent investigation, undertaken in the Purdue University Wood Research Laboratory, has been released as Station Bulletin 633. Inquiries should be sent to the Agricultural Experiment Station, Purdue University, Lafayette, Ind.

Hydraulic research . . . Publications issued to date by the Waterways Experiment Station and reports of hydraulic model investigations sponsored by other offices of the Corps of Engineers are listed in a revised 100-page bibliography. Inquiries about the current "List of Publications" should be referred to the Director, Waterways Experiment Station, Post Office Box 631, Vicksburg, Miss.

Pollution control . . . Results of an investigation of the efficacy of submarine outfall disposal of sewage and sludge—conducted for the California State Water Pollution Control Board by Erman A. Pearson, A.M. ASCE, consulting sanitary engineer—are reported in the Board's Publication No. 14. The 154-page report includes a review of economics, water quality criteria, bacterial viability, effects on marine resources, mechanics of dispersion, ocean currents, and construction, operation, and maintenance of submarine outfalls. Single copies are available to persons and organizations directly concerned with the water-pollution problem and allied fields. Others may purchase copies from the State Printing Division, Documents Section, Sacramento 14, Calif., at $2.00 a copy. This cost includes postage but not the 8-cent sales tax which must be added for California addresses.

(*Continued on page 106*)

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New Publications

(*Continued from page 104*)

Fasteners . . . Bulletin No. 23 of the Virginia Polytechnic Institute Research Laboratory reports further research into the drivability and holding power of heavy-duty "screwtite" masonry nails in concrete. E. George Stern, M. ASCE, research professor at the Institute, is the author. Inquiries should be addressed to Professor Stern at the Wood Research Laboratory, Virginia Polytechnic Institute, Blacksburg, Va.

Sewage treatment plants . . . Contracts amounting to $227.5 million for 716 sewage-treatment plants, including in many places interceptor sewers, were awarded by the nation's muncipalities during 1954. These projects are summarized in Public Health Service Publication No. 453, entitled "Public Sewage Treatment Plant Construction, 1954." Copies, priced at 20 cents each, are for sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C.

Map use . . . To stimulate interest in the use of maps and to aid in their interpretation, Hugh C. Mitchell, Principal Mathematician (retired), U. S. Coast and Geodetic Survey, Washington, D.C., has published an informative and helpful brochure entitled "Maps and Water." Inquiries about the 16-page pamphlet should be sent to Mr. Mitchell.

University of Illinois research . . . For the convenience of persons wishing to order publications of the University of Illinois Engineering Experiment Station, the status of all publications issued between 1904 and 1956 is listed in a recent Cumulative Index. The 40-page index includes author and subject listings and prices (if the publications are still available). Requests for the Cumulative Index should be sent to the Engineering Publications Office, 114 Civil Engineering Hall, University of Illinois, Urbana, Ill.

Rebuilding European cities . . . The persistence of the city is demonstrated once again in the fact that the hundreds of Western European cities destroyed during the war are being rebuilt and, in practically all cases, on the same sites as before. This is the thesis of a 104-page study, entitled "Europe's Reborn Cities," by Prof. Leo Grebler, of Columbia University. In a recent tour of 28 Western European cities, Dr. Grebler noted the endurance of urban growth patterns—particularly the presistence of "downtown." One important change is seen in the fact that "new central business districts have less building coverage, lower residential densities, and practically no industry." Copies of the 104-page illustrated report may be purchased from the Urban Land Institute, 1200 18th Street, N. W., Washington 6, D.C. The price is $5 a copy.

Reinforced concrete research . . . As part of a continuing research program dealing with problems connected with the use of steel reinforcing bars in concrete construction, the Committee on Reinforced Concrete Research of the American Iron and Steel Institute has made available a report of a research program conducted at the National Bureau of Standards under the direction of Arthur P. Clark, A. M. ASCE. The report, which is entitled "Cracking in Reinforced Concrete Flexural Members," is reprinted from the Journal of the American Concrete Institute. There is no charge for individual copies, but a nominal charge is made for quantity shipments. Committee on Reinforced Concrete Research, American Iron and Steel Institute, 350 Fifth Avenue, New York 1, N.Y.

Storm-water inlets . . . A recent volume, entitled "The Design of Storm-Water Inlets," reports all the significant information on the hydraulics of inlets derived from the Storm Drainage Research Project conducted at the Johns Hopkins University during the period, 1949–1955. Included in the 193-page volume is information on curb, gutter, deflector, combination, sump, and multiple inlets in depressed and undepressed settings, and on various crown slopes and gutter grades. For

(*Continued on page 108*)

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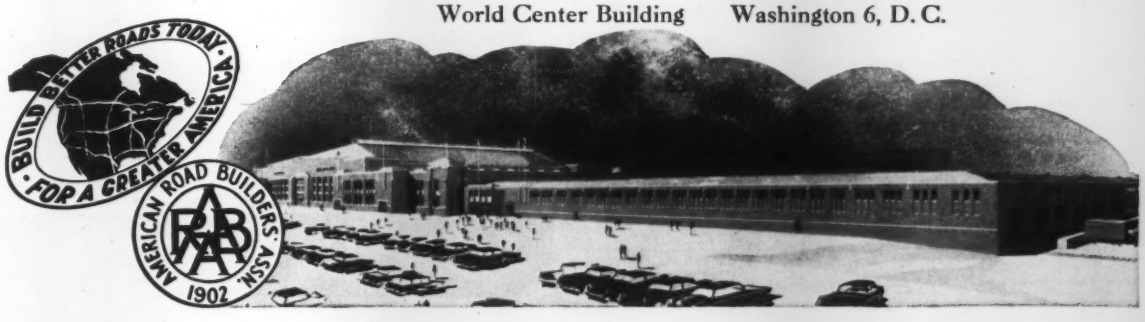

New Publications

(*Continued from page 106*)

routine office use, a quick graphical method for determining capacities of single and multiple inlets is presented. The project was sponsored and financed jointly by the City of Baltimore, Baltimore County, and the Maryland State Roads Commission. The book sells for $5, and may be obtained from Paul Block, Project Engineer, Department of Sanitary Engineering and Water Resources, the Johns Hopkins University, Baltimore 18, Md.

Steel products . . . Continuing revision of its Steel Products Manual, which is being issued in sections, the American Iron and Steel Institute has now made available a revision of former Section 26 on Flat Rolled Electrical Steel. Like the other sections, the present revision covers tolerances, testing, inspection, definitions of technological terms, and other related subjects developing in the manufacture and use of iron and steel. Inquiries should be addressed to the American Iron and Steel Institute, 350 Fifth Avenue, New York 1, N.Y.

Sewage oxidation ponds . . . In recognition of the need for field investigation of sewage oxidation ponds as a means of removing organic matter from sewage effluent, the California State Water Pollution Control Board contracted with the Botany Department of the University of California for a two-year algal-research study. Results of the study, which were concerned with oxidation ponds of the Central Contra Costa Sanitary District and the City of Santa Rosa and pilot plant ponds at Richmond, Calif., are reported in Publication No. 13 of the Board. Single copies are available without charge to persons active in water pollution control. Others may buy copies from the State Printing Division, Documents Section, Sacramento 14, Calif., at 75 cents a copy.

Applications for Admission to ASCE June 9–July 7, 1956

Applying for Member

WILLIAM THOMAS BRADLEY, Carlisle Barracks, Pa.
HERBERT WILLIAM EHRGOTT, Washington, D.C.
JOHN COLT BEAUMONT ELLIOTT, Texas Mineral Wells, Tex.
ALBERT FRANK EWERT, Arkansas, Kan.
MARTIN THEODORE GLASS, Philadelphia, Pa.
WILLIAM FRANKLIN GRAHAM, Newnan, Ga.
GEORGE CLINTON HARRIS, Chicago, Ill.
ROBERT HAILE HAYES, Washington, D.C.
HALL CALDWELL HOWARD, Montgomery, Ala.
ROBERT OGDEN IMHOFF, Wayne, Pa.
HENRY MOUZON JONES, Jackson, Miss.
OTAKAR W. KABELAC, Washington, D.C.
ICHIRO KONISHI, Kyoto, Japan.
MORGAN ROGERS NORTON, Honolulu, Hawaii
EDWIN RICHARD SETTLE, San Diego, Calif.
HERMAN WILLIAM SHUBRING, Olean, N.Y.
DONALD SCOTT WALTER, Boise, Idaho.
EDWARD HORACE WELLS, Syracuse, N.Y.
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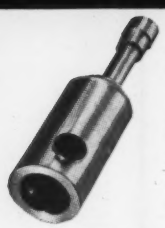

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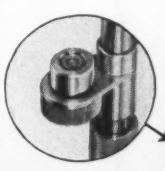

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Eimco 105's do a better job than the conventional tractor mounted machine because of Eimco's exclusive operating features. Independent track operation increases the effectiveness of the machine in speed of maneuverability, saves travel time and wear and tear on track assemblies, chains and all crawler parts.

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B-207

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Men Available

CONSTRUCTION ENGINEER, A.M. ASCE; B.S.C.E.; 38; with experience in design, maintenance and construction of bridges and highways, ten years'. Location desired, west, midwest, east U.S. and Foreign. C-142.

CIVIL ENGINEER, (Sanitary Option) J.M. ASCE; B.C.E. 1954; 25; single, two years' plane and geodetic survey—U.S. Army (Draft Obligation). Interested in training program for field or sales engineering. Available August. Location preferred, New York Metropolitan area. C-143.

STRUCTURAL ENGINEER, A.M. ASCE; 32 years' Metropolitan New York experience in buildings, water works, bridges and sewers, licensed P.E., college graduate, desires permanent connection with reputable firm (not job shops) in New York City or northern New Jersey. Agency fee by employer. Available September 1. C-144.

CIVIL ENGINEER, J.M. ASCE; B.C.E.; 27; registered P.E.; 7 years' experience in both office and field; managed contract work from bidding to completion and served as resident engineer; experienced in sewer, highway, and waterfront works. Location desired, east. C-145.

PLANNING OR HYDRAULIC ENGINEER, A.M. ASCE; B.S. in C.E.; 44; single, 23 years' experience in water supply studies for irrigation, flood control and allied development. Will relocate, travel or accept foreign service, current U.S. Passport, familiar with foreign work. Location desired, South and West or Foreign. C-146.

SANITARY ENGINEER, J.M. ASCE; M.S. in Sanitary Engineering, 25; constructed, operated and developed a water treatment plant of 250,000 gallons per day capacity. Served as project engineer on this job for one and one-half years. Location desired, near a large city. C-147.

CHIEF ENGINEER, Heavy Construction, M.ASCE; M.Eng. (Civil) 49; 30 years' contractors and design engineers. Qualified to take charge engineering and estimating in main office, of contractor on caissons, cofferdams, pile-driving, tunnels, dams, docks, etc., and reinforced concrete construction. Expert in unusual problems. Location desired San Francisco. C-148-San Francisco.

FIELD ENGINEER-ASSISTANT CONSTRUCTION SUPERINTENDENT, J.M. ASCE; 25; B.C.E.; 3 years' construction experience in responsible charge with Civil Engineer Corps, Navy; 1 year with consulting engineer plus additional construction experience. Desires position with general contractor engaged in building construction in the New York City area. C-149.

EXECUTIVE CIVIL ENGINEER; M. ASCE; graduate civil, 1927; registered P.E.; over 28 years' wide experience in construction and maintenance including sanitary engineering, over six years' active duty in Civil Engineer Corps, U.S. Navy; now employed; desires opportunity to become a member with financial interest in consulting firm in the Chicago area. C-150-530-Chicago.

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RECENT GRADUATE ENGINEERS, civil, electrical, mechanical, mining or metallurgical, for mining properties in South America. Salaries, from $6,000 per year. Company will pay placement fee. Transportation and living quarters provided. Single status. Location, South America. F-3407.

ENGINEERS. (*a*) Construction Superintendent, prefer graduate, to 60, with thorough experience on large construction with at least 3 to 4 positions as superintendent of office building construction. Will be responsible for supervising the work on large reinforced concrete office buildings and supervise subcontractors and liaison. (*b*) Construction Superintendent-Power Plants, graduate preferred, with thorough background in supervising construction of large utility steam electric stations, with duties similar to above; to 60. (*c*) Construction Engineer, graduate civil, with construction experience on power plants or

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large industrial buildings, to 40; will assist construction manager in planning and scheduling, writing, and negotiating proposals and contracts, providing liaison between field construction projects and engineering department. Salaries; (*a-b*) $13,000 a year. (*c*) to $8,400 a year. Location, New York, N.Y. W-3436.

LIAISON ENGINEER, civil or mechanical graduate, with administrative and office engineering experience, including construction costs in chemical or metallurgical process fields. Occasional trips. Salary, $8,000–$9,000 a year. Location, New York, N.Y. W-3441.

TOWN ENGINEER, graduate civil, with P.E. license, 30–45, with experience in town planning, roads, structures, etc. Salary, $6,400–$7,000 a year. Location, Westchester County, New York. W-3444.

CIVIL ENGINEER, registered, preferably with municipal engineering background, capable of organizing a new department and running it to service the town government. Salary, to $8,500 a year. Location, Connecticut. W-3462.

PROJECT ENGINEER, civil; to be responsible for the handling of siting, grading, storm drainage, streets and highway design. Will layout work for, supervise and check the work of 10 to 12 Japanese. Location, Far East. F-3485(a).

DESIGNER, CIVIL, capable of independent design action in water works, sewerage grading, siting, streets and highway design. Salary open. Location, Hawaii. F-3486.

ENGINEERS. (*a*) Specification Writer, with civil training and at least 5 years' hydroelectric construction experience preferably in Latin America. Salary, $10,000–$12,000 a year plus extras. (*b*) Chief Draftsman, with civil training and at least 5 years supervisory drafting experience in heavy construction including hydroelectric dam work. Salary, $8,000–$10,000 a year, plus extras. Location, Colombia, South America. F-3512.

RELOCATION ENGINEER, 40–55, on railroad and highway relocation in reservoir of hydroelectric project; must be experienced in railroad and highway engineering with minimum of 10 years' responsible charge of this class of construction. Salary, to $12,000 a year. Locations, Western United States. W-3529.

SANITARY ENGINEER, experienced in the design of sewage and water treatment plants. Apply by letter stating experience, salary, and availability. Location, New York State. W-3536.

CONSTRUCTION SUPERINTENDENT with at least 10 years' experience covering small homes, utilities, streets and erection of shopping centers. Salary, $12,000–$15,000 a year. Location, Maryland. W-3572.

SUPERVISOR OF CONSTRUCTION ENGINEERING, graduate civil or architectural, with several years experience in field construction supervision. Will supervise all architectural engineering and all contracts and sub-contracts for construction. Location, upstate New York. W-3587.

SENIOR HYDRAULIC ENGINEER, civil graduate, with at least 10 years' experience in design, project engineering and field survey, covering water supply and distribution systems. Salary, $7,200–$9,000 a year. Location, New York, N.Y. W-3589.

CONSTRUCTION SUPERINTENDENTS with considerable experience in foundation work for steam power plants. Salary open. Location, upstate New York. W-3612(*a*).

SUPERINTENDENT with heavy construction experience for river flood control project. Salary, $10,000 a year. Location, Massachusetts. W-3635.

INSTRUCTOR for civil engineering department, young, preferably with Master's degree; previous teaching experience not required for an instructorship. Courses to be taught are in the fields of surveying and soil mechanics, hydraulics and transportation if not qualified for soils work. Salary, $3,600–$4,200 for 9 month period; teaching at summer session at extra compensation optional. Location, Pennsylvania. W-3637.

HIGHWAY AND BRIDGE DESIGNERS AND DRAFTSMEN work in Rhode Island area. Apply by letter giving full details as to education and experience. Salary open. W-3645.

HYDRAULIC ENGINEERS with considerable experience for work covering dams of all types, foundations and almost every type of civil engineering as covered by the hydroelectric field. Salaries open. Location, Philadelphia, Pennsylvania. W-3657.

(Continued on page 112)

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(Continued from page 111)

HYDRAULIC ENGINEERS with considerable experience, for work covering dams of all types, foundations and almost every type of civil engineering as covered by the hydroelectric field. Salary, $15,000 a year, plus $300 a month living expenses; all transportation paid for man and family. About a 2-year contract. Location, Middle East. F-3658.

CONSTRUCTION ENGINEERS graduate mechanical or civil, 30–45, with some experience as a project engineer, to be responsible for the field supervision of new construction work. Work will be on the modernization and construction of new manufacturing plants and facilities. Salary, $7,500–$9,000 a year. Location, Southern New Jersey. W-3659.

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TEACHING PERSONNEL for civil engineering department. (*a*) Associate Professor. (*b*) Instructor. Salaries open, dependent upon education and experience. Location, Pennsylvania. W-3675.

JOB CONSTRUCTION ENGINEER with office and field engineering experience covering installation of power and process piping. Salary, $7,800–$9,100 a year, plus allowances. Location, Alabama. W-3681.

ASSISTANT OR ASSOCIATE PROFESSORS to teach material testing laboratory or railway highway and surveying. M.S. in civil engineering and industrial and/or teaching experience. Salary open. Positions available September. Location, Middle East. F-3707(a).

SANITARY ENGINEER for sales work in industrial and municipal waste disposal field. Should have experience or degree in sanitary engineering. Salary open, based on qualifications. Location, Philadelphia, Pa. W-3722.

INSTRUCTOR OR ASSOCIATE PROFESSOR, mechanical or civil graduates, to teach under graduate classes in civil or mechanical engineering; subjects include supervising laboratory phases; for a university of engineering. Salary, $4,800–$6,000 a year. Location, Nevada. C-5136.

FIELD ENGINEER, civil graduate, up to 40; with one or more years experience in railroad bridge or construction work on concrete. Will do field promotional and application work on use of concrete with railroads 50% traveling for an associate of trade. Employer will pay placement fee. Salary, $7,000–$8,400 a year. Location, Chicago. C-5137.

CHIEF BRIDGE ENGINEER, civil or structural graduates, 35–60, with 10 years' experience in structural design and three years' on bridge; to design highway bridges; organize, supervise bridge engineering department for consulting engineers working under contract to state highway departments. Some traveling. Employer will pay placement fee. Salary, $7,500–$10,000 a year. Location, Missouri. C-5187.

BRIDGE DESIGNERS, civil or structural, 25–65, 3 years' experience in bridge and structural design concrete or steel. To do design drafting of bridges for highway construction; some traveling. Employer will pay placement fee. Salary, $5,400 a year. Location, Missouri. C-5188.

CHIEF CIVIL ENGINEER, civil, to 45, with 5 or more years supervisory design and construction of heavy industrial buildings. Must know stresses, vibrations, etc. Will supervise all structural design and construction of flour mills and food processing plants for a miller of flour. Employer will pay placement fee. Salary, $10,800–$12,000 a year. Location, Minnesota. C-5219.

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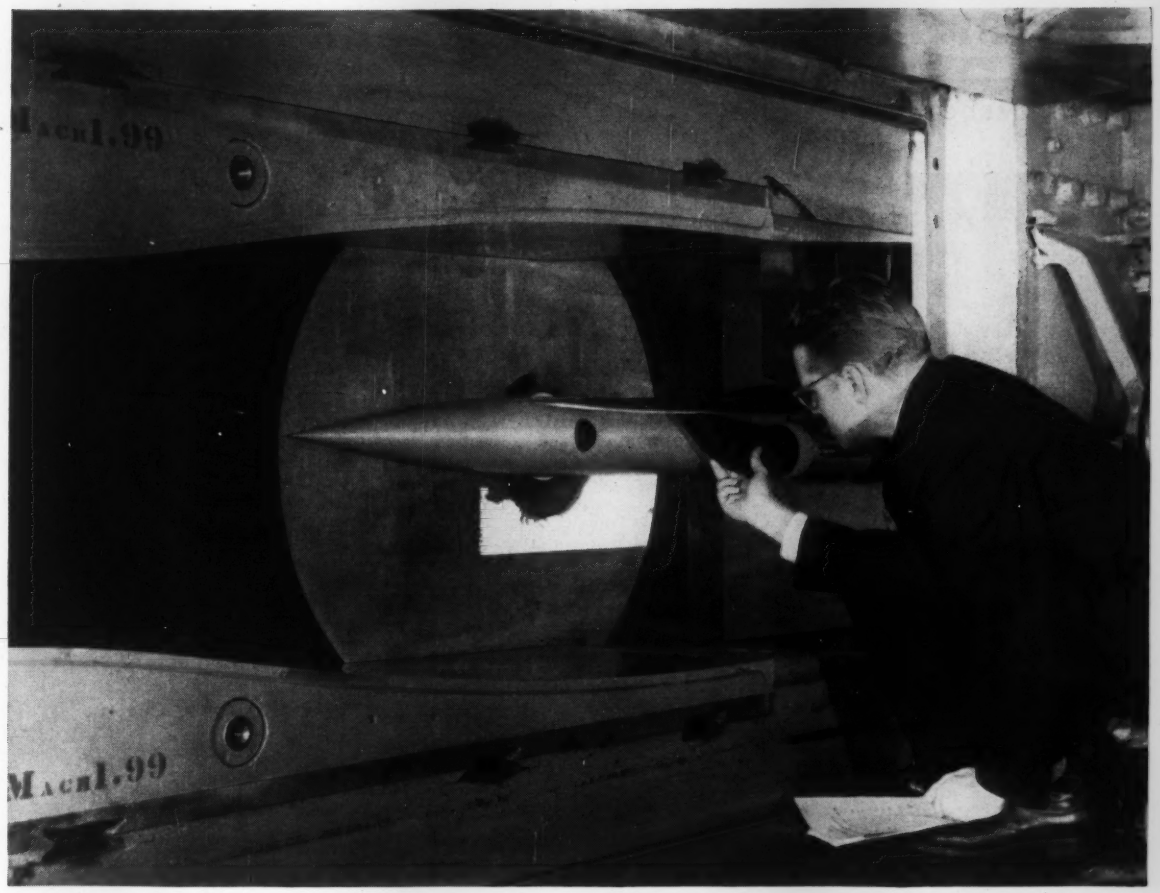

Supersonic jet inlet: an example of Boeing-Wichita research

This Boeing-Wichita engineer is checking the installation of a model supersonic engine inlet design prior to wind tunnel testing at M.I.T. Data on engine inlet performance at high Mach numbers obtained from such tests is now being applied to the design of future supersonic airplanes. This is just one example of Boeing-Wichita's continuing development of advanced aircraft and associated system components.

Wichita engineers find unparalleled opportunities for creative effort in advanced fields, and have the finest research and development facilities in the United States at their disposal. Boeing-Wichita's own laboratory space has been increased 400%, and many other new engineering facilities have been added to keep pace with increasing emphasis on technical development.

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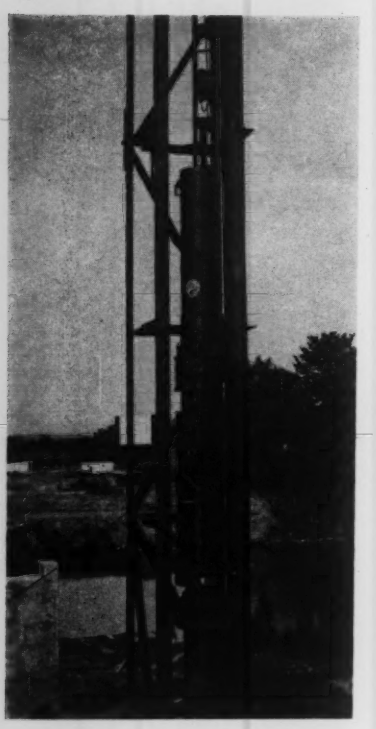


Model D12

Diesel Pile Hammers

FIRST DEVELOPED IN GERMANY in 1938, Delmag diesel pile hammers have recently been introduced in this country. Due to their many advantages over steam or air operated pile hammers, they are revolutionizing the pile driving phase of the construction industry.

The hammer consists mainly of a long cylinder. The falling weight or ram serves as the piston. The piston or ram strikes the hammer head or anvil, which sets on the helmet or pile and is held in the cylinder by retainers. The fuel tank is a part of the cylinder and the fuel pump is mounted on the cylinder.

To start the hammer the piston is lifted. This operation is accomplished by an automatic notching attachment, which is operated by one of the crane lines and operates on the same guides as the hammer. When starting, the notching attachment is lowered to a point on the cylinder where it automatically engages the piston. It is then raised along the cylinder until it automatically releases the piston at a certain height. As the piston falls of its own weight, it activates the fuel pump which injects, at low pressure, fuel into the concave recess in the anvil. The piston (ram) then hits the anvil (hammer head) driving the pile.

All hammers are easily and simply adapted to use with cranes and conventional leads, both fixed and swinging. **The Foundation Equipment Corp., CE 8-114, 100 Elizabeth St., Newcomerstown, Ohio.**

Deltaform

DESIGNED FOR INEXPENSIVE and simple forming of piers, short columns or pads, Deltaform, a disposable fibre form for concrete has been introduced.

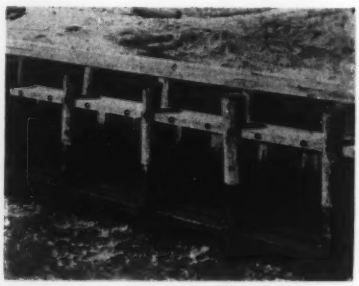
Packed in flat convenient bundles, these forms are extremely light, easy to handle and require practically no storage space. They are quickly set—just open, stand in place and pour. No bracing is necessary.

Being disposable, Deltaform is set and then forgotten, eliminating the old method of building and setting forms and then another trip back to strip and move such forms.

It is claimed to be the lowest cost method of forming as there is no capital investment in forms, no heavy form handling and hauling and no maintenance. Delivered to the site in precut lengths there is no adjusting or cutting on the job, reducing waste and labor greatly. **The Delta Company, CE 8-114, 333 W. 24th Place, Chicago 16, Ill.**

Permanent Sheet Piling

OF CURRENT INTEREST IS THE increased use of Greenheart sheet piling for bulkheads, groins, and heavy marine construction. Greenheart is an exceedingly high strength timber with a safe working stress in bending of 3300 psi. In addition, these bulkheads are virtually maintenance free, since they are resistent to fire, teredo, rot, fungus, termites, ants, erosion, corrosion, and abrasion. Designs using alternate materials are proof that these installations are lower in both initial and maintenance costs.



High Strength Timber

Band sawn Greenheart lumber is readily available in thicknesses $1^1/_2$-in. and up, and in lengths up to 32 ft for use in Wakefield, spline, shiplap, and single sheet plain or tongue and groove. **Greenheart (Demerara) Inc., CE 8-114, 52 Vanderbuilt Ave., New York 17, N. Y.**

New Instrument Measures Durability of Asphalt Pavements

A NEW INSTRUMENT THAT MAKES POSSIBLE the first accurate predictions of the life expectancy of asphalts is now available for general use.

The instrument, a sliding plate microviscometer, measures the viscosity—resistance to flow—of asphalt under carefully controlled temperatures and shear forces. Its accurate measurements permit selection of asphalts with proper viscosity and great resistance to change, and thus construction of uniformly superior asphalt roads. The microviscometer provides precise answers to questions that paving experts previously had to handle in general terms.

The key to precision in the test is that measurements are made on an extremely thin film of asphalt—about a hundredth of a millimeter thick. This is the thickness of asphalt that binds stones together in roads and streets.

Scientists using such samples can run tests under conditions similar to those existing in ordinary pavements. Earlier tests, made on thick layers of asphalt, gave results that had little or no relation to the performance of asphalt as it exists in typical pavements.

To gauge the asphalt's durability, the scientists measure the viscosity of the film, subject it to aging processes, then measure the viscosity again.

The chief advantage of the instrument, according to Shell, is that it provides data never before attainable and hence enables highway construction people to plan roads more efficiently. Results indicating the durability of the sample being tested are expressed in absolute physical units.

To make a test with the microviscometer, a scientist puts a minute quantity of asphalt between two polished glass plates and presses it out to form a thin film. One plate is then moved across the other and the sample is thus sheared. The shearing force and temperature are carefully controlled and recorded.

The instrument is manufactured by Hallikainen Instruments, Berkeley, California. Detailed information and technical data are available from **Shell Oil Company. CE 8-114, 50 West 50th Street, New York 20, N. Y.**

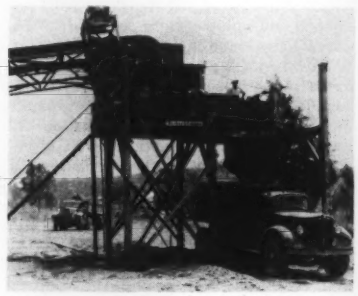
EQUIPMENT, MATERIALS and METHODS

(continued)

Stabilization Pugmill

A LOW-COST, HIGH-CAPACITY mixing pugmill, especially designed for the needs of the stabilization mixing field, has just been announced.

With job tonnages in stabilization work often exceeding the 100,000 ton point, the 350 ton per hour (and higher) capacity of the twin-shaft pugmill promises lower job costs through quicker completion. Thorough mixing of the material is assured by the accepted twin-shaft pugmill, and through the use of a hydraulically controlled, 5 cu yd discharge hopper which serves as a dam to control the height of the material in the pugmill and the duration of the mixing time. It is 8 ft long, 2 ft 9 in. deep and 4 ft 8 in. wide. Paddle tips are specially hard coated for abrasion resistance.



350 TPH Capacity

Designed for use with cement, calcium chloride and other water-mixed stabilizing agents, the pugmill is equipped with water spray bars and an accurate meter-centrifugal pump combination which can supply as much as 150 gpm to the pugmill. **Barber-Greene, CE 8-115, 400 No. Highland Ave., Aurora, Ill.**

Nelson Stud Welding

A NEW TECHNIQUE FOR SECURING concrete forms, involving a combination of end welded studs and coil form ties, was employed by Webb & Knapp Construction Corp. during construction of the basement walls for the new Court House Square building in Denver, Colorado. It was probably the simplest, most economical, and safest fastening method they could have devised and turned a potentially difficult task into a fairly easy one.

The first step in the procedure was to end weld large diameter Nelson studs to the vertical soldier beams of the basement cofferdam walls with a Nelson heavy-duty NS-9 stud welding gun. Two battery units hooked up in parallel were used as the power source. The studs were $^3/_4$-in. in diameter and 6 in. long, with $5\text{-}^1/_2$ in. of broad threads sized to fit the coils of the form ties, furnished by Superior Concrete Accessories, Inc.

On the extreme upper lift, where a double form was required, the form was built in place with the sheathing boards fitted over the studs. Coil form ties were then threaded to the studs and the prefabricated inside form was erected. On the lower three lifts, concrete was placed directly against the cofferdam wall, eliminating the outside form. Prefabricated panels consisted of 4-ft by 10-ft $^3/_4$-in. plyform, with 2-in. by 6-in. studs 12 in. on centers. Walers consisted of 6-in. double channel iron, back to back. Forms were secured by running $^3/_4$-in. lag bolts through the waler and threading into the free end of the coil form tie.

Nelson studs were spaced 6 ft center to center on the horizontal plan and 2 ft on center vertically. Theoretical load on each stud and tie was 12,000 lb.

The two battery units supplying the power were mounted side by side on a single timber platform. **Nelson Stud Welding Division of Morton Gregory Corp., CE 8-115, 2727 E. 28th & Toledo Ave., Lorain, Ohio.**

Model E 14″ Long—$7.00
with irregular curve adjusting feature — $8.50
Other Models 1′-6″ and 2′-0″ priced from $10.00
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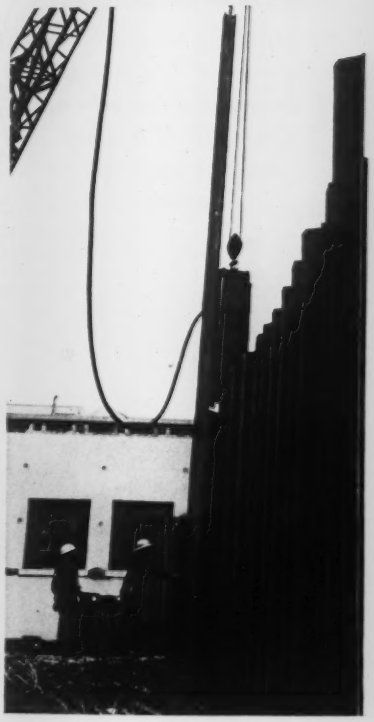
At 3 P.M....

CAVE-IN!



Cave-ins will happen, through no fault of the contractor. On this excavation job, there was erratic soil behavior, shifting loads, saturating rain . . . everything unpredictable.

When it happened, L. B. Foster Co. was called at 3 P.M. for rental steel-sheet piling *in a rush*. We cut MP-116 piling in our yard, and delivered it in Foster trucks to the job site 400 miles away before the crews started work next morning.

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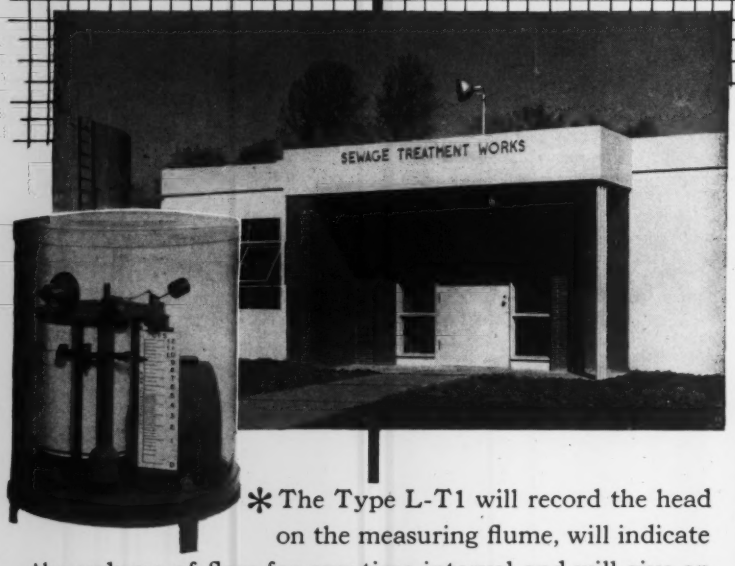
SOLUTION:
Stevens Type L-T1 Recorder*



* The Type L-T1 will record the head on the measuring flume, will indicate the volume of flow for any time interval and will give an instantaneous reading of the rate of flow. The head record, made on convenient rectangular coordinates, is basic information for permanent record from which plant operators and State Sanitary Engineers can check flows and volumes. The volume reading from the totalizer dials and the rate of flow indicator are essential for intelligent operation. Readings can be made in any desired volume and flow units.

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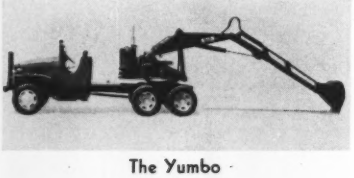
EQUIPMENT MATERIALS and METHODS

(continued)

Hydraulic Shovel

NEW TO THE CONSTRUCTION industry in the United States, the Yumbo, a hydraulic shovel was developed seven years ago in Italy. Its outstanding features are a precision built ball bearing turntable and heavy duty hydraulic system. An all purpose tool, it has the following attachments; 1/4-yd backhoe, 5/8-yd front dump bucket, 3/8-yd rock bucket, 5/8-yd gravel bucket, 1/2-yd clamshell and a 6500-lb crane hook. One man can make a change of attachments in ten min easily. The backhoe has a digging depth of 10-ft and a clear dumping height of 10-ft. The shovel has a dumping height of 10-ft.

The turntable consists of lower and upper races, integral gear and center race, and 168 ball bearings. It is practically dust proof and periodic lubrication will force out any dust particles that try to work into the bearings. The Yumbo is the only shovel which has a ball bearing turntable with two races of balls working in compression. It reduces friction to a minimum, giving smooth, fast action under load and permits 360-deg continuous rotation, left or right. Made in Germany by a company which specializes in production of these slewing rims up to 16-ft in diam with capacities to 1000-tons, the turntable is guaranteed for one year and the estimated minimum life is 30,



The Yumbo

000-hr. It eliminates center pins, turntable rollers, external exposed gears, and adjustment and lining up of rings.

The heavy duty hydraulic system includes three double acting cylinders, one hydraulic motor, four two-way control valves and a hydraulic pump. The unit requires only 30-hp and is equipped with an International U169 gasoline engine or equivalent. A very important feature of this system is that steel swivel joints and high pressure steel tubing eliminate rubber hose and main working cylinders. The hydraulic system provides power for penetration on all backhoe and shovel digging operations and eliminates multiple gears, chains, sprockets, sheaves, cable, etc. The controls are spring loaded to return to neutral position when released. The machine stops and holds its position instantly upon release of control levers. The simplicity of the shovel practically eliminates maintenance. **Geco, Inc., CE 8-116, 5701 Colorado Blvd., P. O. Box 177, Denver, Colo.**

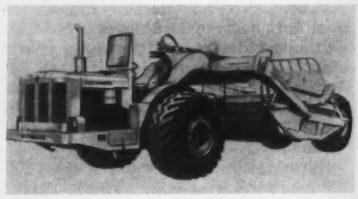
(continued)

New 200 H. P. Motor Scraper

A NEW 200-HP UNIT WEIGHING approximately 39,600 lb, the TS-260 Motor Scraper is being introduced. The 14 cu yd heaped capacity of the TS-260 is rated for high production in this medium sized motor scraper. Powered by a 6-cylinder Allis-Chalmers Diesel engine a high yardage to horsepower ratio is maintained. Another value of unit performance is the favorable horsepower to gross weight ratio, built into the unit.

These two ratios point to the proper balance between horsepower, capacity and weight built into the TS-260 and are evidence of power plus, to move full load, give fast acceleration and ample reserve power.

Other design, engineering, construction and operating features add further to the scraper's performance and long life. A hydraulic pump, gear driven from the rear of the engine crankshaft, provides positive drive and assures constant live power for steering and scraper operation. The curved bottom and three piece cutting edge with offset center edge gives faster penetration and better loading with "live" action. Positive forward ejection plus high apron lift provides fast clean spreading. All these combine to speed up the earth-moving cycle for more loads per day and more profitable operations.



Model TS-260

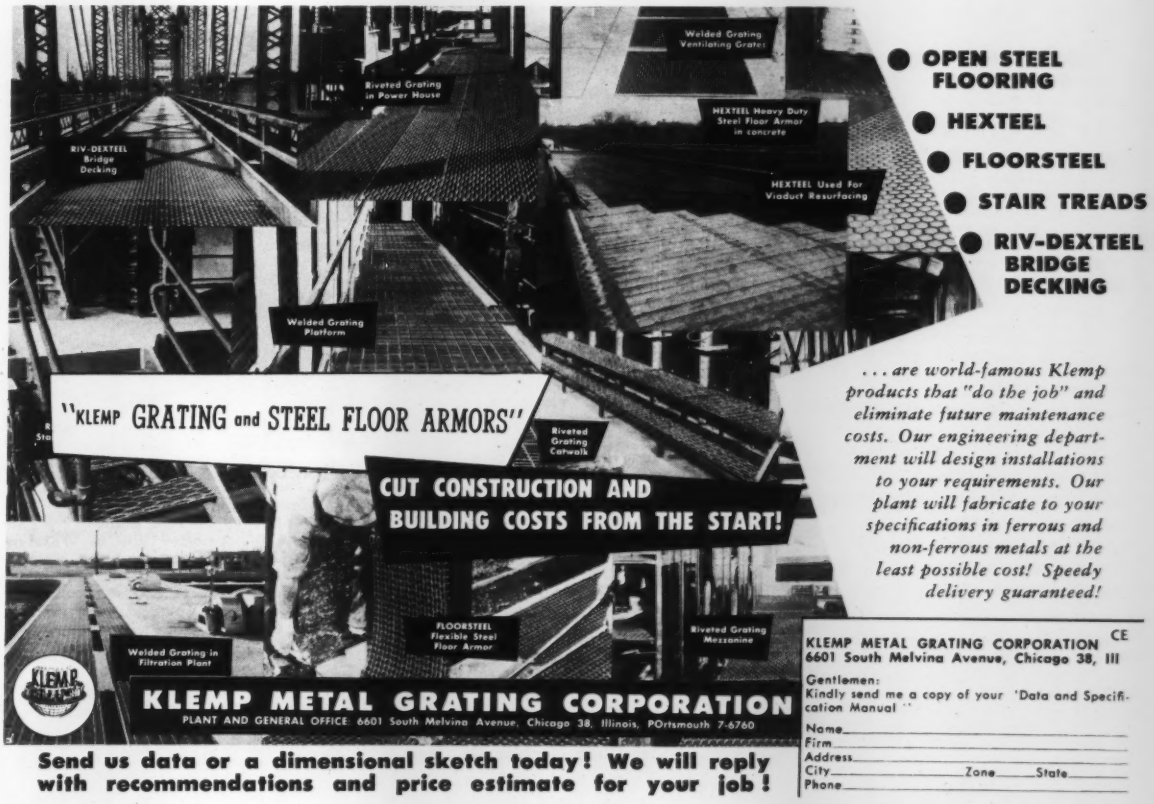
Among features designed into the new scraper is a selective hydraulic steering which provides two-speed steering by action of a steering control valve that is actuated from the wheel by direct linkage.

Accurate distribution of weight provides maximum traction, flotation and tire life. When empty, 66% of the entire weight is carried on the tractor wheels and the remaining 34% by the scraper wheels. When loaded, each tire supports an equal amount of weight.

Other engineering features include all-steel welded box-type frame for rigid support and maximum true alignment of the power train.

Among the plus comforts and safety features for the operator are the conveniently positioned controls; control tower visibility from the foam rubber cushioned and upholstered bucket-type adjustable seat behind a shatterproof windshield, and the 24-v turnkey electric starting system. For cold weather starting, an ether primer is provided.

Optional equipment and attachments available for the TS-260 include 26.50 × 25 wide-base tubeless tires as replacements for the 21.00 × 25 which are standard on the unit. To meet highway weight limits when the scraper is being transported over highways, quickly attachable auxiliary wheels that work on the caster principal and follow desired direction of travel automatically are available. These attach to the front bumper. **Allis-Chalmers Manufacturing Co., CE 8-117, Milwaukee, Wis.**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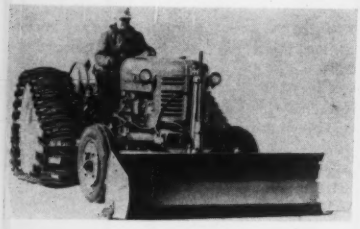
EQUIPMENT MATERIALS and METHODS

(continued)

Dual Action Dozer

A DOZER FOR THE NEW International-Harvester IHC-300 utility tractor has recently been announced. Called the Dual-Action because of the double-acting hydraulic cylinder on the blade, it will afford, in combination with the I-H Hydra-Tough control valve, enough positive hydraulic down-pressure on the blade to afford penetration in hard and partially frozen soils.

By using the versatile blade, the IHC-300 can perform a large variety of jobs, including removing topsoil and backfilling, grading, bulldozing, snow plowing



Versatile Blade

and even shallow excavations. When also equipped with Arps half-tracks, as shown in photo, the tractor has enough added crawler traction and power to handle the roughest dozing, plowing and filling operations.

A wide range of blade adjustments on the dozer further adds to the versatility of the unit. There are five angular adjustments for the blade so that it may serve either as a bulldozer or as an angledozer. In addition, there are three adjustments for the cutting pitch.

The blade is furnished in a six ft length. In operation, it has no effect on the rear end linkage of the tractor, which means that other attachments, such as a utility blade or trencher, can be used at the same time. **Arps Corporation, CE 8-118, New Holstein, Wis.**

New Flushing Gun

A NEW UNIT CALLED THE Plumber's All Purpose Flushing Gun has been introduced. By using water impact and air pressure, it is claimed that this gun can clean all lines up to a 100 ft. Easily operated, toilets, urinals, sinks and floor drains, clogged with paper, grease rags, sand and other debris can be cleaned with one or more shots from the gun. It will make any number of bends in the pipe and can be used on any ½ in. to 6 in. waste pipe. Obstructions melt away instantly when struck by the hammer blow of this unit. **Miller Drain Cleaning Co., Dept., CE 8-118, 4642 N. Central Ave., Chicago 30, Ill.**

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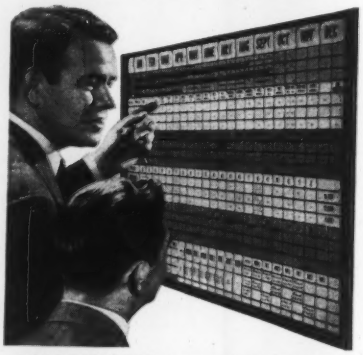

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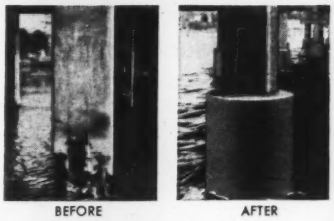

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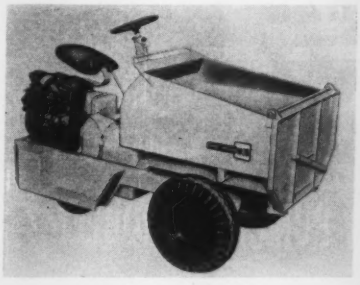
EQUIPMENT MATERIALS and METHODS

(continued)

Torque Converter Drive Truck

A NEW 18-CU FT, 1½-TON CAPACITY construction materials handling truck with torque converter drive has been introduced. According to the manufacturer, this is the first truck of its kind in the construction field that incorporates a hydraulic torque converter.

The new truck has a top speed of 12-mph to comply with all state regulations. It is powered by a Wisconsin 15 hp air cooled engine, heavy duty Model TFD with electric starting—direct coupled to a transmission consisting of a three element torque converter and directional change clutches. Engine and transmission are coupled to the differential with an automotive type drive shaft. No belts or chains are used.

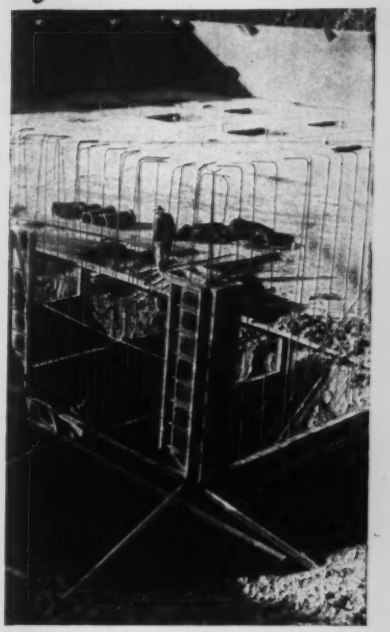


Model M30

Operation of the truck is said to be safe, simple and smooth. The operator sets the directional change lever in either forward or reverse, presses the accelerator to move, and presses the brake pedal to stop. Wear and tear on all mechanical parts are cushioned by the hydraulic torque converter, and maintenance is simplified by having most parts immersed in oil. Smooth starts and acceleration eliminate spillage of liquid loads or shifting of stacked materials. Steady flow of power takes steep inclines or inches slowly for accurate spotting and placing of loads.

The Model M30 Prime-Mover is engineered for speedy delivery of building materials in quantity on long haul jobs such as bridges, piers, airports, parking garages, etc. Standard beds available from stock for the M30 include an 18-cu ft bulk handling bed and a 42-in. x 42-in. flatbed. The bulk handling bed has a sliding endgate, swinging tailgate, and dumping controls to accommodate any rate of load discharge. Over-all width of the truck with bed is 42-in. and overall length is 88½-in. Height to top of bulk bed is 42-in. **The Prime-Mover Co., CE 8-119, Muscatine, Iowa.**

Symons FIELD REPORT...



Contractor Saves 40% with Symons Forms . . .

7,500 square feet of Symons Standard Forms were used in the new 2 million gallon capacity pumping station at Melrose Park, Illinois. 2,000 cubic yards of concrete were used on the job and the concrete contractor, Louis Macro Company, Melrose Park, reported a 40 per cent saving through the use of Symons Forms. Walls for the job were completed in three pours.

Symons engineering service can help you realize substantial savings in forming. With your plans, our engineers will prepare a complete form layout, bill of materials, and make recommendations for the most efficient and cost saving method of forming.

Our field service representatives are sales engineers, ready and able to advise you on form erection, pouring and stripping methods that will help you save time, labor and materials. You can call on them to assist you on any forming problems.

Symons Forms can be rented with purchase option. Symons Clamp & Mfg. Co., 4291 Diversey Avenue, Dept. H-6, Chicago 39, Illinois.

Sam Cerniglia Company, Melrose Park, Illinois General Contractor.

Catalogs and Added Information on FORMS—CLAMPS—SHORES Sent on Request

10,000 feet of bedrock profile surveyed in 7 days on rugged highway site

In relocating the Marlborough-Colchester section of Connecticut's main highway Route 2, F. P. Malloy Company, contracting engineers of West Hartford, needed to know bedrock depth in cut areas and elastic properties of the overburden, Rough terrain made the site almost inaccessible. A Gahagan Seismic Survey Crew was called in. Using portable equipment, they surveyed approximately 10,000 linear feet in just seven working days in October 1955; gave client a continuous profile of bedrock depth and overburden characteristics. In the same area a boring crew took $2\frac{1}{2}$ weeks to put down six test holes. These checked out well with seismic findings. Design engineers today save much time and money, obtain a wealth of extra information through Gahagan Seismic Surveys. Write for Bulletin 2 to Geophysical Survey Division, Gahagan Dredging Corp., 90 Broad St., New York 4, N. Y.

Established in 1898, Gahagan is a leader in hydraulic dredging

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EQUIPMENT MATERIALS and METHODS

(continued)

Modern Designed Transportation

THE HTS MODEL LOW BED TRAILER is a new conception of low bed trailer building. After extensive study and research this model was designed to enable haulers of heavy equipment maximum payload capacity without reduction of any trailer strength. The deck is 14-ft long, a length which it has been determined meets the requirements of the majority of users of this type trailer. Constructed almost entirely of Hi-Tensile steel, the clean and completely new design of this model has achieved a weight one ton or more lower than other trailers of the same capacity. This new low weight combined with reduced overall length increases the loads which can be transported legally. New flat type gooseneck incorporates tool box and provides ideal support for blades, shovels and many other loads.

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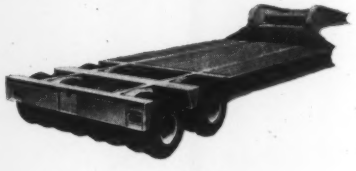

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HIGH STRENGTH BOLTS—A twenty-page illustrated booklet, No. HS 1, giving the man on the job practical working information on high strength bolts has just been published. Designed as a working guide for ironworkers in the fast growing technique of joining structural steel members, the theory of bolting is explained in ABC terms, and technical findings helpful to bolting crews and other men on the job are summarized in easily understandable form through use of photos and line drawings. Sections of the booklet are devoted to identification of high strength bolts and proper sizes, comparisons with machine bolts, use of hardened washers, and good installation practices, also included is data on proper tightening, calibration of impact wrenches, air supply and inspection techniques. **The Russell, Burdsall & Ward Bolt and Nut Company, CE 8-121, Port Chester, N. Y.**

CAT-BUILT BULLDOZERS—The extreme value and versatility of bulldozers in the earthmoving business is emphasized in a new 8-page booklet No. DE616 just released. "Cat-Built Bulldozers . . . The Answer to Profitable Earthmoving" points out that there is a bulldozer designed for all track-type tractors in the Caterpillar line. Actual job shots of these dozers in action bear out their ability when the going gets rough. Not only are the dozers designed to move the earth economically, but a wide selection of useful attachments increase the work output of the dozer into such operations as raking rock and cutting trees. **Caterpillar Tractor Co., CE 8-121, Peoria, Ill.**

PLASTIC TAPES—A new four-page manual describing uses for Scotch brand pressure sensitive tapes in the construction industry has been made available. It illustrates in detail how tapes are applied in sealing operations, used as masking material to save cleanup time and provides answers to special construction problems. Thirteen specific examples of tape uses, illustrated with on the scene photographs, show how tapes can be employed to seal joints in concrete forms and cartons used in void construction. **Minnesota Mining and Manufacturing Co., CE 8-121, 900 Fauquier Street, St. Paul 6, Minn.**

TANDEM ROLLER—Comprehensive specification sheets on its new 3-5 ton tandem roller with torque converter and water-cooled engine are now offered. The two sheets list complete information on design, construction, materials and capacities. One gives basic information on the standard 3-5 ton tandem and the other covers the 3-5 ton with its towing attachment which converts the tandem into a highly portable unit and can be either supplied with the machine or purchased later and bolted on in the field. **Huber Warco Co., CE 8-121, Marion, Ohio.**

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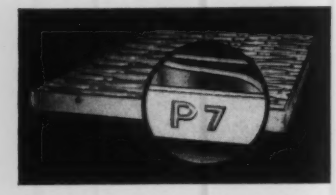

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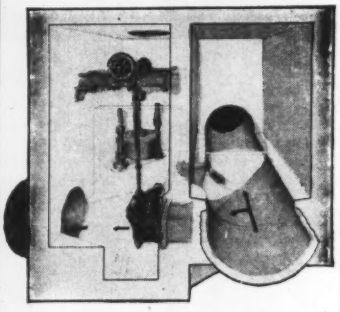

Fig. B-19

Automatic Sewage Regulators control sewage flows either by partially or completely cutting off such flows to suit head or tail water conditions or by "governing" to discharge a predetermined quantity regardless of head or tail water conditions.

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1014. Investigation of Planned Refuse Collection and Disposal: SED Research Report No. 7, Sanitary Engineering Research Committee, Rubbish and Garbage Section. (SA) The results of seven years of investigation to develop a planned refuse disposal program for the Los Angeles County Sanitation Districts are summarized and critically evaluated.

1015. Proportional Weirs for Sedimentation Tanks, by J. C. Stevens. (HY) For grit channels or other types of sedimentation tanks it is desirable to control automatically the mean velocity through the tanks in order to obtain the most favorable conditions for settlement of the solids contained in the influent. This can be done by installing a properly formed weir in the outlet end of the tank.

1016. The 1954 Drought and Its Effect on Ground Water, by G. A. Muilenburg. (SA) Drought conditions prevalent in Missouri and neighboring areas from 1952 to 1954 reached a maximum in the summer of 1954. The cumulative deficiency from the two preceding years was 22.77 inches, and this was largely responsible for the disastrous conditions which marked 1954 as the worst in history.

1017. Arch Dams: Development in Italy, by C. Semenza. (PO) The reasons for extensive development of arch dams in Italy are listed and the historical stages of that development are traced. The methods of analysis are briefly reviewed and special features of construction procedure are given. The benefits of the peripheral point, which has been successfully used by the author, are explained.

1018. Arch Dams: Design of the Kamishiiba Arch Dam, by C. C. Bonin and H. W. Stuber. (PO) The first arch dam in the Far East, the Kamishiiba Dam, was dedicated in 1955 as part of the 90,000-kilowatt-capacity Kamishiiba Hydroelectric Development. This paper describes terrain, hydrologic conditions, foundation material, design assumptions, and methods of analysis pertaining to this project.

1019. Development and Design of the Walt Whitman Bridge, by Milton Brumer and C. W. Hanson. (ST) The historical development and design features of a major bridge project are presented, beginning with the point at which it becomes apparent that some type of new cross-river traffic facility must be provided. The numerous phases of study and the influences leading to the final selection of location and type of crossing are described. The Walt Whitman Bridge, a suspension bridge having a 2,000-ft center span, should be listed among the world's major bridges. The problems of design of the main foundations are discussed and the criteria for design of the superstructure are presented in detail. The new facility is scheduled to open for traffic early in 1957.

1020. Moments in Flat Slabs, by Mark W. Huggins and Watone L. Lin. (ST) This paper summarizes the results of a study of moments in a cast-aluminum model of a flat slab floor. All panels were square and the columns and capitals were round. There were no drop panels. The model was two bays by three bays and was tested under air pressure with a pattern type loading. Moments obtained from SR-4 strain gage readings are compared with those obtained by continuous frame analysis following the American Concrete Institute Code (ACI-318-51).

1021. Bending Stresses in Edge Stiffened Domes, by Mario G. Salvadori and Robert Sherman. (ST) Bending moments and shears in certain types of thin shells of revolution stiffened by an edge beam are obtained, and graphs for their evaluation are given. Variable, symmetrical live and dead loads are considered, together with temperature and shrinkage stresses. Approximate but accurate values of the maximum moments in the shell and supporting cylinder are derived by means of the same graphs, when the dome is built-in into a cylinder and stiffened by an edge beam.

1022. Simplification of Design by Ultimate Strength Procedures, by Phil M. Ferguson. (ST) Based on the 1956 "Report of ASCE-ACI Joint Committee on Ultimate Strength Design" and on the use of a rectangular stress block, design procedures for beams and columns are developed. Although the use of design charts is recommended, it is shown that most computations are simple and practical without such aids. Design procedures are, moreover, simpler than present working stress methods. The Appendix contains some numerical examples.

1023. The Load Distribution in Highway Bridge Decks, by Arnold W. Hendry and Leslie G. Jaeger. (ST) The authors have previously described a new method for the

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analysis of grid frameworks with particular reference to interconnected bridge girders. It is the purpose of the present paper to show the extension of the method to slabs and to bridge decks having a large number of longitudinal girders. Comparisons are presented between the theoretical load distribution and the results of tests on actual bridges and large models.

1024. Discussion of Proceedings Papers 651, 734, 786, 851, 869, 917. (ST) M. H. Bell closure to 651. A. Hoadley closure to 734. F. P. Drew closure to 786. R. L. Ketter, L. S. Beedle on 851. J. F. Borges on 869. E. Rosenblueth on 917.

1025. Experiences with Loess as Foundation Material, by William A. Clevenger. (SM) In this paper, broad generalizations of many pertinent properties of loess are presented, and the practical significance of these properties is pointed out by typical examples of experience with loess as foundation material.

1026. Redriving Characteristics of Piles, by Nai-Chen Yang. (SM) In evaluating the bearing capacity of a pile, the present technique can be improved. The temporary stress adjustments in the subsoil after pile driving have effects which, to some extent, invalidate the application of pile-driving formulas. For pile-loading tests, the excessive expense often prevents the determination of all quantitative information necessary for conclusive interpretation. The purpose of this paper is to present the results of observations made during the redriving of piles and to discuss their possible applications.

1027. A Brief Note on Compression Index of Soil, by Yoshichika Nishida. (SM) This paper reports a new relationship between the compression index and the void ratio of soils after a theoretical consideration of some simple assumptions. The relationship presented by the author agrees well with experimental results of verification and gives a new approximate method of estimating the compression index of soils as a linear function of the void ratio.

1028. Discussion of Proceedings Papers 514, 755, 842, 861, 862, 866, 940. (SM) D. J. Bleifuss and J. P. Hawke closure to 514. H. Gray closure to 755. L. A. DuBose, Y. Nishida, J. D. Parsons, and R. B. Peck on 842. G. G. Meyerhof, E. S. Barber on 861. E. J. Zegarra, W. A. Brown on 862. N. C. Yang, S. G. Hyland, L. J. Murdock, W. J. Turnbull and R. I. Kaufman, J. A. Focht, Jr., on 866. Corrections to 940.

1029. Creep Relaxation of Plexiglas IIA for Simple Stresses, by Joseph Marin and J. E. Griffith. (EM) Many investigations have been conducted to determine the creep strain-stress-time relations for materials subjected to simple tension and constant stress. However, in a number of applications where creep occurs the stresses do not remain constant and the so-called condition of stress-relaxation occurs. To the authors' knowledge, the only stress-relaxation creep studies conducted in the past have been for the case of simple tension. In this paper, experimental creep-relaxation results for a plastic designated as Plexiglas IIA are obtained for simple tension, simple compression, and pure bending. The agreement between experimental and derived relationships is considered satisfactory.

1030. Suppression of the Fluid-Induced Vibration of Circular Cylinders, by Peter Price. (EM) An investigation of the vibration of circular cylinders in fluid streams has been made in an effort to evolve a means of suppressing the dangerous, wind-induced oscillation of tall steel smokestacks. Exploratory vibration tests of plain and modified cylinders were made over a wide range of cylinder flexibility at subcritical Reynolds numbers in a water channel. These tests established that the enclosure of a cylinder within a concentric perforated shroud was the most effective vibration suppressor at transitional and supercritical Reynolds numbers.

1031. Some Observations on Open Channel Flow at Small Reynolds Numbers, by Lorenz G. Straub, Edward Silberman, and Herbert C. Nelson. (EM) The paper is confined to a summarization and correlation of the results of a number of studies of open channel flow in the range of Reynolds numbers below approximately 4×10^4. Hydraulic diameter is used as the length parameter in Reynolds numbers. Smooth laminar, smooth turbulent, rough laminar, and rough turbulent flow are considered separately, as is transition from laminar to turbulent flow in smooth channels.

1032. Lateral Bracing Forces on Beams and Columns, by William Zuk. (EM) Slender beams and columns are generally braced against buckling to increase their strength. Yet little is known about the magnitude of the bracing force and it is usually assumed to be some small value based on engineering judgment. It is therefore the purpose of this paper to derive quantitatively the amounts of bracing force required for eight representative cases of beams and columns. Some of the cases are solved exactly by the direct solution of the basic differential equation whereas others are solved approximately by energy methods. In all cases, the behavior is assumed elastic. Several numerical examples are included which show that the order of magnitude of these bracing forces is small and falls within a limited range.

1033. Discussion of Proceedings Paper 694. (EM) F. E. Richart, Jr., on 694.

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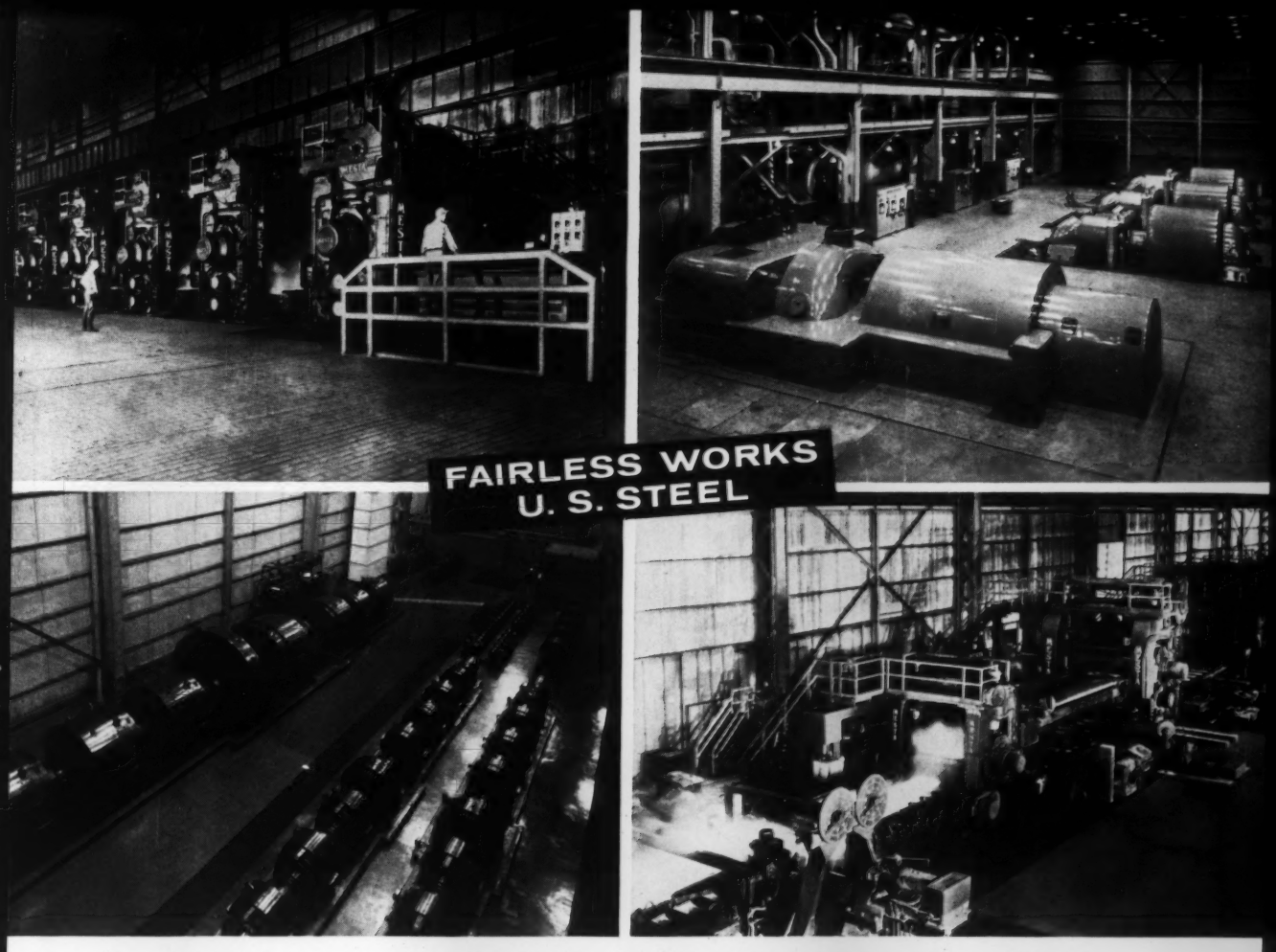

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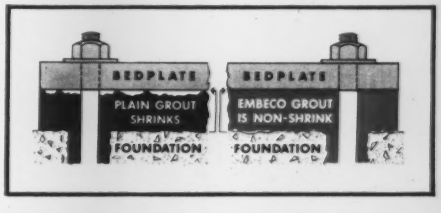

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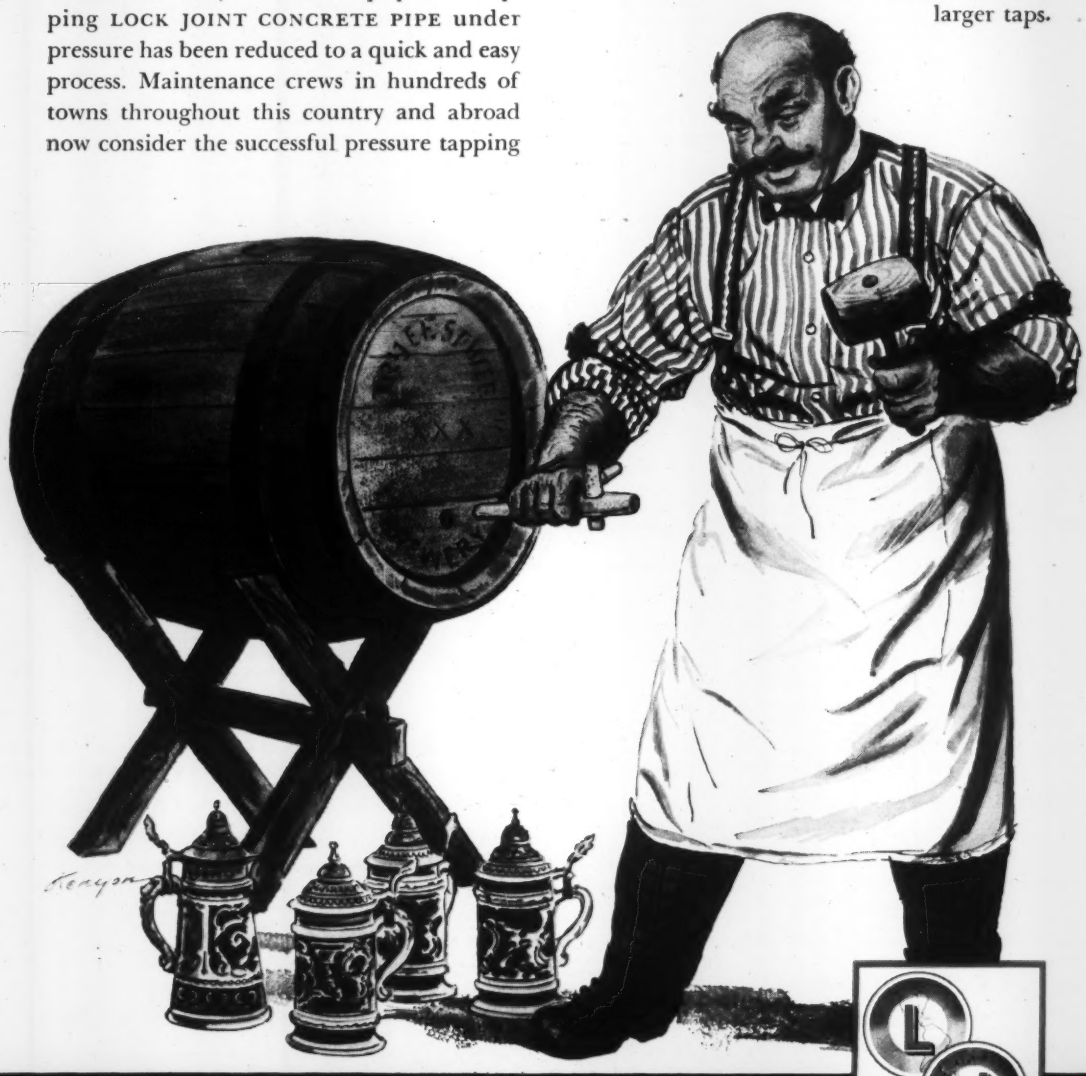

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